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ERRATA GRAVIORA

p. 130. Plate is inverted; caption names should read right to left instead of left to right.

No. 4, front cover: Title of article Galium correllii (Rubiaceae), a new species from Val Verde County, Texas, does not match that actually used on p. 249: A new species of Galium (Rubiaceae) from Texas.

No. 5, front cover: Date given as July 1969, but issue was not mailed until 6 August.

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WOODY VINES OF THE SOUTHEASTERN STATES

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Woody vines have rarely been treated as a separate group in respect to guides or systematic studies. Instead they have usually been included with treatments of other vascular plants, sometimes with the shrubs which generally have been much neglected. In temperate or cold climates woody vines are easily delimited, much more clearly than are trees from shrubs. Therefore, it is logical to treat the woody vines as a group.

The species included in this study are woody vines which are native to some part of the Southeastern States or were introduced to the area and have escaped and reproduced naturally in one or more localities. Included among the escapes, for example, are *Lonicera japonica* which reproduces abundantly both vegetatively and by seeds, *Pueraria lobata* which rarely reproduces by seeds but spreads rapidly vegatively, and *Hedera helix* which probably spreads by vegetative means only. Two species, *Ampelopsis aconitifolia* and *Periploca graeca,* are known from only one locality each. There may be other species which have escaped but which I have not observed or for which I have not seen a documenting specimen. Other introductions which are used in some areas as ornamentals do not seem to have become established permanently outside of domestication and are not included here. Some of these, such as *Ficus pumila* L., may be shown later to be escapes.

Opinion varies as to just what constitutes a woody vine. In order to establish for others the scope of this study it is best to define the criteria employed here. One requirement is that in some part of the Southeastern United States, some individual of a species be known to have aboveground stems which live over one year to the next through the winter freezes. A second criterion is that some individuals be able to climb as a result of some specific activity in addition to mere growth in length; such activities include twining, or the use of tendrils or aerial roots. Included, therefore, are species which in the colder parts of their range have individuals without stems persisting above the ground during some winters. *Clematis virginiana,* for example, sometimes dies back to the ground, or nearly so, during the winter, yet in the mountainous Blue Ridge Province a stem is known to have persisted for several years to 13 feet above the ground. Included also is *Smilax pumila,* a species of the Coastal Plain, low in stature, often trailing, but occasionally low climbing by means of tendrils and having aboveground stems clearly persisting over the winter season. Omitted are various species which climb to a few to many feet, but during the winter die

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back to near the ground, producing during the following growing season new growth from these short aboveground stems.

Of the criteria regarding climbing, twining of stems is an easily observed character as likewise is the twining of the leafstalks of *Clematis virginiana*. The presence of aerial roots also is easily seen. However, in *Parthenocissus* the tendrils are short and usually tipped with discs and sometimes may be misinterpreted as roots. Otherwise tendrils are distinct structures. They may be either stems as in *Vitis*, stipules *(Smilax)*, or reduced leaflets *(Anisostichus)*.

The above criteria for climbing involve specific activities other than the matter of growth in length of stems. I have omitted from the woody vines, therefore, species such as *Sagereta minutifolia* (Michx.) Trel. and *Rosa multiflora* Thunb. which are deemed climbers by some, but which do nothing more than grow abundantly in length and merely rest on other plants and objects for support. Included is *Pieris phillyreifolia* whose stems often follow the crevices in the bark or force a path between the outer and inner bark of *Taxodium ascendens* Brongn.

Much consideration was given to the problem of the geographical limits for this study. The point of departure was that area covered by Small's (1933) *Manual of the Southeastern Flora*. The decision in regard to areas that should be dropped and those to be added was based largely on evaluation of the natural distribution of woody species (trees, shrubs, and vines). The addition of Louisiana, Arkansas, Kentucky, Virginia, West Virginia, Maryland, and Delaware to the area involves no additional species of woody vines and only a few species of trees and shrubs. Including any one additional state adds a significant number of woody species. Therefore, it seems best to include in the area of this study the seven states named above, each of whose woody flora is so similar to that of adjacent parts of the Small's *Manual* range, and to exclude all additional states. These exclusions seem justified also because part of the area of each omitted state has additional woody species which are more characteristic of other types of floras than those in the Small's *Manual* range.

In peninsular Florida the criteria set up for woody plants are sometimes difficult to interpret. There are areas, especially in the southern part of the peninsula, which are often free of freezing and aboveground stems of many species live from year to year. The farther south one goes the more difficult it is to decide, under the test of the aboveground stem living through winter freezes, whether or not a species is woody, and a sensible list of woody plants is difficult to compile. Fortunately, a southern boundary may be established reasonably on a different basis north of the area where it is difficult to decide for many species whether or not they are woody.

By extending the area of the present study south of Georgia to the

southern boundaries of Pasco, Sumter, Lake, Orange, and Volusia Counties, Florida, only two species of woody vines, *Vitis shuttleworthii* and *Passiflora pallida* and a few species of trees and shrubs are added to the list of woody plants for the Southeastern States under an interpretation that a woody plant is one in which most of the main aboveground stem lives for a period of several years. It is assumed that the stems of some of the species might die to the ground during the "killer" freezes which usually occur at intervals of a good many years.

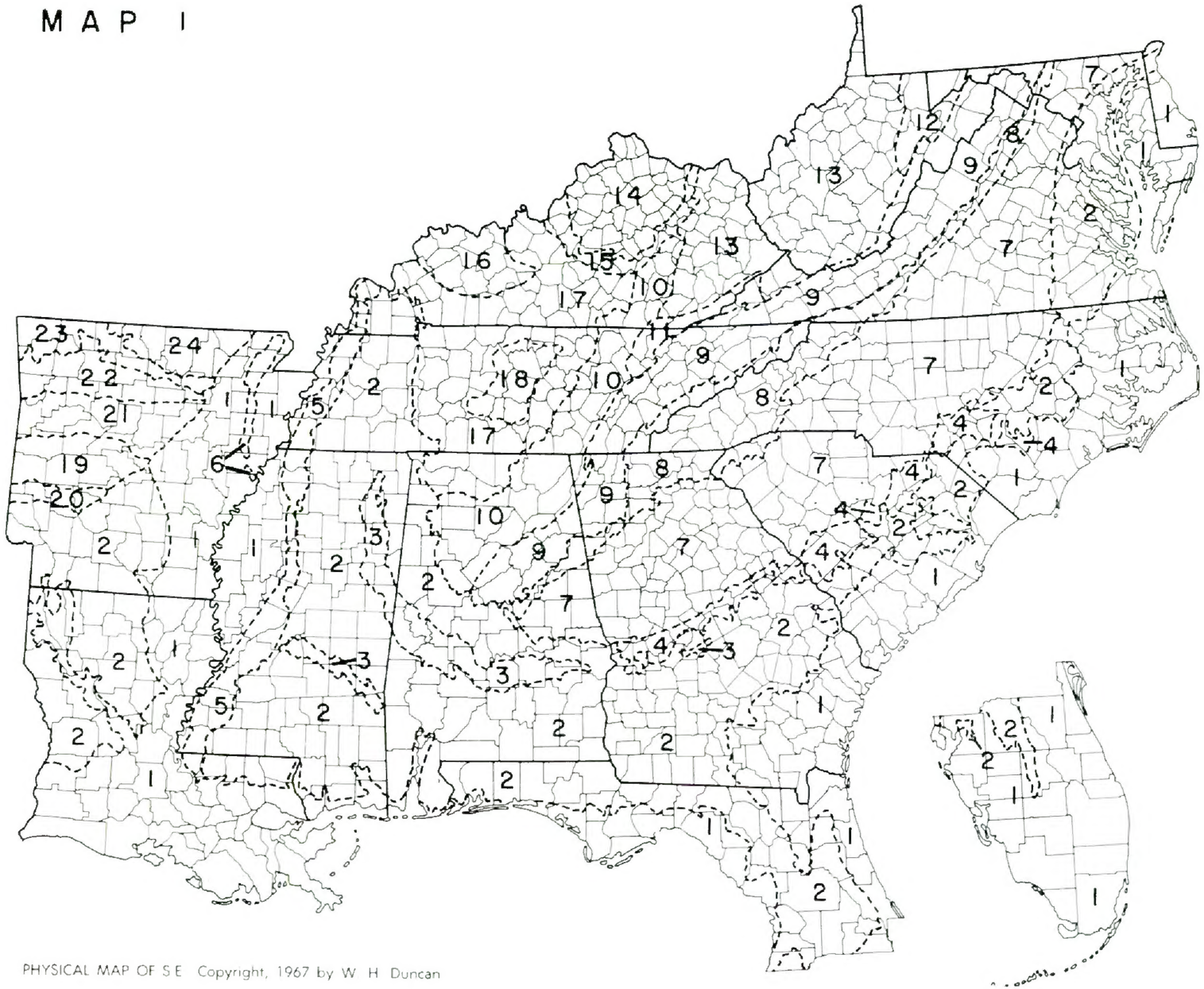
Should the next tier of counties (five) to the south be included in the area, several woody species would be added and the problem of deciding whether or not other species were woody would present considerable difficulty. Furthermore, these additional species are characteristically more subtropical in affinity than temperate, of which almost all of the woody vines of this study are a part. Therefore, the southern boundaries of the counties named above are a logical choice for the southern limits of the present study.

The area for this study is indicated by Map 1. The remainder of Florida is included so that distributions of the species occurring in the study area can be indicated by county for all of Florida. The map also shows physical regions for the Southeastern States. The boundaries of the physical regions were established after exhaustive search for and studies of published materials, some having appeared during the last year.

The regions are based largely on a combination of classification of soils, physical relief, and the underlying geological formations; they are not intended to reflect the distribution of plants but rather to aid in the interpretation of their distribution. The designations for most of the regions may be recognized as those generally employed in current physiographic maps of the area although the boundaries are often different. A few designations are my adaptations and are designed to describe the regions. Edaphic and physical features within some regions are sometimes widely and abruptly divergent. For example, in the Piedmont of Georgia there are the deep fertile soils on one hand and the granitic outcrops on the other. The Lower Coastal Plain includes coastal dunes, salt marshes, flatwood pineland areas, swamps, sandhills associated with rivers, and other types of features. Such features are often important in respect to plant distribution. It is impossible, however, to indicate most of these features on any but large scale maps. In addition, detailed data concerning physical aspects of many areas are lacking, and it is impossible to subdivide on a uniform basis an entire region such as the Lower Coastal Plain.

My studies of woody plants of the Southeastern States have covered a period of over twenty-five years. They began with an attempt to recognize all woody taxa under the interpretations of current authors, to establish more definitely distributions for the taxa, and to interpret

MAP I



PHYSICAL MAP OF S E Copyright, 1967 by W H Duncan

PHYSICAL MAP OF THE SOUTHEASTERN STATES

A. COASTAL PLAIN
  a. LOWER COASTAL PLAIN 1
  b. UPPER COASTAL PLAIN 2
    BLACK BELT 3
    SANDHILLS 4
    DEEP LOESS 5
    CROWLEYS RIDGE 6
B. PIEDMONT 7
C. BLUE RIDGE 8
D. RIDGE AND VALLEY 9
E. CUMBERLAND PROVINCE
  a. CUMBERLAND PLATEAU 10
  b. CUMBERLAND MOUNTAINS 11
F. ALLEGHENY PROVINCE
  a. ALLEGHENY MOUNTAINS 12
  b. KANAWHA PLATEAU 13
G. INTERIOR LOW PLATEAU
  a. BLUE GRASS REGION 14
  b. KNOBS REGION 15
  c. SHAWNEE REGION 16
  d. HIGHLAND RIM 17
  e. NASHVILLE BASIN 18
H. OUACHITA PROVINCE
  a. OUACHITA MOUNTAINS 19
  b. ATHENS PIEDMONT 20
  c. ARKANSAS VALLEY 21
I. OZARK PLATEAU
  a. BOSTON MOUNTAINS 22
  b. SPRINGFIELD PLATEAU 23
  c. SALEM PLATEAU 24

better the vegetation of the Southeast. These endeavors soon showed that the then current interpretations of many taxa differed from author to author and/or needed modifications. Therefore I added the matter of solving some of the taxonomic problems to my endeavors. Every opportunity allowed by teaching responsibilities was taken to study collections in herbaria and to get into the field and obtain data and specimens. Few attempts were made to conclude studies of any particular group of species to the extent that publication of the results would be justified because overall studies in the field are more economical in terms of time and costs than studies concerning only a few species. The studies have now reached a point where it seems appropriate to place certain conclusions into print.

Some of the taxonomic problems encountered have been solved to my satisfaction; others definitely have not and need further study. Even in such cases a setting down of interim conclusions and a discussion of some of the relationships between and the nature of the taxa involved should be valuable in helping establish the character of future studies. The tabulated distribution records which were obtained from specimens in 36 herbaria* during the last eleven months allow a realistic appraisal of the numbers of specimens available for taxonomic studies from the various areas of the Southeast. It is clear that over large areas little or no additional field work is needed to obtain sufficient general collections, especially for floristic studies. It is equally evident that considerably more work is required in other areas. However, the amount of general collecting needed in the Southeast does not reach the proportions that apparently have been assumed by some students of the flora. General collections from much of the Southeast seem sufficient to allow intelligent planning of most systematic studies. Special additional collections will, of course, be needed from all areas for the various systematic studies which will undoubtedly be made.

Many persons have contributed to the data that are presented and their help is gratefully acknowledged. Information useful in preparation of the physical map was received from numerous individuals. The curators of all the herbaria which I either visited or from which I received data or specimens on loan were all most generous with their attention. Other individuals, both at the University of Georgia and elsewhere, contributed specimens and data which were helpful. Wayne Faircloth, in particular, during part of a summer developed keys many of which have been modified and used here. The illustrations were drawn by Mrs. Delia McClung, many being from living materials. Financial support for some of the more recent portions of the study was received through Dr. Robert McRorie, Director of General Research, University of Georgia, and Dr. Lloyd Shinners, Southern Methodist University;

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* See Appendix for list of herbaria.

earlier portions of the study were supported financially through a number of other sources.

The material to follow places emphasis on those characteristics and relationships of taxa in which my interpretations differ from those in the more recent manuals. Descriptive and explanatory materials are generally omitted for those taxa for which my interpretation and those of the other manuals are essentially the same. When our interpretations are the same and an identical scientific name is used no reference to other manuals is given. If the scientific name applied to a taxon is different or if my interpretation of taxa differs from that of the other manuals, the scientific names involved in the other manuals are indicated and identified to source by abbreviations as follows:

F—Fernald, M. L., 1950, *Gray's Manual of Botany,* American Book Company, New York.

G—Gleason, H. A., 1952, *The New Britton and Brown Illustrated Flora of the Northeastern United States and Adjacent Canada*—3 volumes, The New York Botanical Garden, New York.

GC—Gleason, H. A. and Cronquist, A., 1963, *Manual of Vascular Plants of Northeastern United States and Adjacent Canada,* D. Van Nostrand Company, Inc., Princeton, N. J.

R—Radford, A. E., et al., 1964, *Guide to the Vascular Flora of the Carolinas,* University of North Carolina Book Exchange, Chapel Hill, N. C.

S—Small, J. K., 1933, *Manual of the Southeastern Flora,* University of North Carolina Press, Chapel Hill, N. C.

SC—Strausbaugh, P. D. and Core, E. L., 1964, *Flora of West Virginia,* West Virginia University Bulletin, Morgantown, W. Va.

Full names of the authors sometimes are used. Scientific names listed as synonyms and without a designating abbreviation are from authors other than the above. The keys are mostly artificial, being designed for those persons who are relatively unfamiliar with woody vines.

From the above discussion it may be seen that much of the material presented below involves descriptions or explanations of those of my conclusions which differ from interpretations of other current authors. Under such an arrangement most of the repetitious descriptive material can be omitted without significantly affecting the reader's ability to understand what is presented. The manuscript has also been shortened by other means. A number of words are abbreviated and periods omitted following them. Numbers higher than "one" usually are not written out. The word "leaves" is used to refer to "blades of the leaves" unless otherwise indicated. Instead of an index, generic numbers from Dalla Torre and Harms' *Genera Siphonogamarum* are used as a reference in going from the general key to the treatment of the genera and to the distribution maps. When distribution records are few the maps are omit-

ted and the data given in the text. The data on the distribution maps are from two sources, herbarium specimen records which are indicated by black circles and observations in the field which are indicated by triangles.

I decided many years ago that there was little justification for placing specimens in the herbarium to document a detailed record of plant distribution by counties. It seemed more logical in many cases to obtain and file a single specimen from one county of each group of counties which were physically similar, and to record sight records from the other counties. I began tabulation of such records in ledger books and followed that by notching records on Key Sort cards. Since 1952 most observations have been recorded on a dictating machine run from the electrical system of the field automobile. Some plants were observed from the automobile. An eight-power binocular was often used in the automobile, and when I was away from it as well. Often specimens collected in the field were placed in a vasculum, a plastic bag, or even in my pockets, and upon my return to the automobile they were recorded by taxon on the dictating machine. Distribution records of the more easily identified common species, e.g., *Smilax glauca* and *Pueraria lobata,* were frequently recorded by dictation. Uncommon species and/or those easily confused with another taxon were usually documented with herbarium specimens.

The presence of species in any of the states adjacent to the SE is indicated in the text.

The chromosome numbers of species are indicated by numerals in the parentheses following the statement of distribution outside the SE. The numbers are all sporophytic although some values were calculated from reported gametophytic numbers. A parenthesis without a number indicates that no published chromosome number was discovered. No check was made concerning whether or not having two different numbers for the same taxon was due to misidentification.

KEY TO GENERA

a. Leaves compound (in *Cissus* some leaves, but not all, only deeply 3-parted . . . . . b

b. Leaves opposite. c

c. Leaves of two ovate to oblong entire leaflets and a branched tendril with adhesive discs by which the plants climb. . . . . 7705. ANISOSTICHUS

c. Leaves of 3 or 7-13 toothed leaflets and no tendrils; the plants climbing by aerial roots or twisting leaf stalks. . . . . d

d. Leaflets 7-13; climbing by aerial roots; corolla tubular. . . . . 7714. CAMPSIS

d. Leaflets 3; climbing by twisting leaf stalks; corolla none; the sepals petal-like and separate. . . 2542. CLEMATIS

b. Leaves alternate. . . . . e
e. Leaflets with a small notch in the otherwise rounded apex, the margins entire. . . . . 2555. AKEBIA
e. Leaflets with an acute or obtuse apex, the margins serrate, dentate, lobed, or entire. . . . . f
f. Plants climbing by aerial roots; leaflets 3 (or rarely 5) and pinnate; fruit drupaceous. . . 4594. TOXICODENDRON
f. Plants climbing by twining or tendrils (the tendrils sometimes similar to roots and having adhesive discs on their ends); leaflets 3 to many, palmate or pinnate; fruit a legume or 1—4-seeded berry. . . . . g
g. Stems twining, plants without tendrils, fruit a legume. h
h. Leaflets 3, the largest 10 cm or more long. . . . . 3889. PUERARIA
h. Leaflets 7-19, the largest under 10 cm long. . . . . 3722. WISTERIA
g. Stems not twining, plants with tendrils (one species with adhesive discs on the ends), fruit a 1—4-seeded berry. i
i. Leaves bi-pinnately or (partially tri-pinnately) compound, the leaflets many. . . . . 4916. AMPELOPSIS
i. Leaves palmately compound (or apparently so), leaflets 3-5 . . . . . j
j. Leaflets 3, tendrils opposite all or most nodes. . . . . 4918. CISSUS
j. Leaflets 5, rarely some also 3. . . . . k
k. Leaflets evenly finely to coarsely serrate above an entire basal portion, tendrils tipped with adhesive discs. . . . . 4915. PARTHENOCISSUS
k. Leaflets pinnately lobed, often divided nearly to the midrib; tendrils with no discs. . . . . 4916. AMPELOPSIS

a. Leaves simple (some deeply lobed). l
l. Leaves opposite or rarely whorled. . . . . m
m. Stems climbing by aerial roots. . . . 3222. DECUMARIA
m. Stems climbing by twining. . . . . n
n. Leaves narrowly linear, the largest under 4 mm. wide; plant often profusely branching. . . . 6797A. CYNANCHUM
n. Leaves much wider. . . . . o
o. Lacking stipules but the stem usually with lines between opposing leaves; leaves deciduous or semi-evergreen; fruit fleshy, a berry. . . . . 8523. LONICERA

o. Bearing sharp-pointed, triangular, often elongated stipules either on the petiole base or adjacent stem, the stipules sometimes early deciduous; either with or without stipular lines between opposing leaves; leaves deciduous or evergreen; fruit dry and dehiscent at maturity. . . . . p

p. Leaves evergreen, leathery, glabrous; corolla conspicuously yellow, the tube over 15 mm long; fruit a 2-celled capsule, flattened contrary to the partition; seeds without hairy tufts at ends. . . . . 6447. GELSEMIUM

p. Leaves deciduous, not leathery, sometimes pubescent; corolla pale yellow to brownish, rotate or with a tube to 7 mm long; fruit of a single or twin follicles; seeds with hairy tufts at ends. . . . . q

q. Lateral veins of leaves uniting to form a marginal vein about one mm from the edge; corolla rotate. . . . . 6733. PERIPLOCA

q. Lateral veins of leaves gradually tapering until indistinct very near the margin, where essentially parallel with it; corolla with a tube about 7 mm. long. . . . . 6667. TRACHELOSPERMUM

l. Leaves alternate. . . . . r

r. Pith lacking; the stems solid except sometimes for scattered pores, with scattered vascular strands; tendrils arising in pairs from the petioles of leaves; prickles often present on stems. . . . . 1151. SMILAX

r. Pith present or stems rarely hollow; tendrils absent or if present not arising from the petioles of leaves; no prickles present on stems. . . . . s

s. Stems growing in fissures of the bark or growing under the outer bark, usually of cypress. . . . . 6200A. PIERIS

s. Climbing by tendrils, aerial roots, or twining. . . . . t

t. Climbing by tendrils or aerial roots. . . . . u

u. Climbing by aerial roots. . . . . 5855. HEDERA

u. Climbing by tendrils only. v

v. Leaves entire and not lobed, ovate; petiole dilated at base and extending into a minutely pubescent ring (stipular) surrounding the stem; tendrils limited to the ends of the branches; stem grooved. . . . . 2206. BRUNNICHIA

v. Leaves toothed or lobed, or if unlobed or entire the stem not grooved (sometimes with soft corky ridges); petioles not as above; tendrils opposite

leaves and thus apparently lateral to stems although basically terminal. . . . . w
w. Petiole bearing two stalked glands between its middle and the blade; stems, except youngest, with tight almost white corky longitudinal strips or sometimes covered with the cork; flowers and fruits one per pedicel, solitary to two in leaf axils. . . . 5372. PASSIFLORA
w. Glands absent from petiole; the stems lacking the whitish cork, older stems sometimes with rough brownish bark or the brownish bark sometimes shredding; flowers and fruits several to many in clusters attached opposite leaves. x
x. Year-old stems having white continuous pith; leaves shallowly serrate or toothed, sometimes lobed; petals spreading at flowering-time and later dropping singly; mature fruit a turquoise blue, not edible; inflorescence a cyme; bark of stems tight.
. . . . . 4916. AMPELOPSIS
x. Year-old stems having brown pith with cross partitions at the nodes, except in *V. rotundifolia;* leaves palmately lobed or angled, or coarsely toothed; petals separating only at their bases and falling as a unit; mature fruit black or purple, edible although sometimes sour or bitter; inflorescence a panicle; bark or stems of most species loosening into elongated flakes or shreds. . 4909. VITIS
t. Climbing by twining. . . . . y
y. Leaves palmately veined. . . . . z
z. Petiole attached inside the edge of the leaf-blade on the underside (occasionally on some leaves by as little as one mm). . 2567. MENISPERMUM
z. Petiole joining the edge of the leaf-blade at its base. . . . . aa
aa. Leaves not lobed, cordate to broadly ovate; fruit a capsule. . . 2174. ARISTOLOCHIA
aa. Leaves slightly to deeply lobed; fruit a drupe.
. . . . . bb
bb. Leaves deeply 3—5-lobed, the middle lobe narrower at the base than in the middle; tips of lobes sharply pointed but not mucronate; at least seven veins arising from leaf-

base; the lowermost ones often obscure; bud-area not vertically elongate or hairy; leaves glabrous beneath except for sparse hairs on the larger veins; drupe black, 15-25 mm long and flattened only on one side.
. . . . . 2599. CALYCOCARPUM

bb. Leaves not lobed or only slightly so; leaf-tips mucronate; not more than five (rarely seven) veins arising from the leaf-base, the lowermost ones often obscure; bud-area vertically elongate and densely hairy; leaves silky-pubescent beneath; drupe red, 5-8 mm long and flattened on both sides.
. . . . . 2570. COCCULUS

y. Leaves pinnately veined. cc

cc. Pinnate veins of leaves nearly straight, evenly spaced, and parallel. . . 4868. BERCHEMIA

cc. Pinnate veins of leaves not straight, evenly spaced or parallel. . . . . dd

dd. Leaf-scars orbicular, with three bundle scars; leaf-margin with minute, widely scattered serrations confined mainly to the distal part of the leaf blade; petioles of largest leaves 3-5 cm long. . . . . 2656. SCHIZANDRA

dd. Leaf-scars half circular (truncate beneath the bud), with one bundle scar; leaf-margin with distinct and rather uniformly distributed serrations; petioles rarely over 2 cm long.
. . . . . 4625. CELASTRUS

LILIACEAE **LILY FAMILY**

There is only one genus having species which are woody vines. Other taxa are trees, shrubs, or vines.

1151. SMILAX L.

The interpretations of the woody species of this genus in most manuals seem generally correct. However, the abundant misidentifications of herbarium specimens, particularly of sterile ones, indicate difficulties in following these interpretations even by authors of the manuals, and suggest the need for additional diagnostic characters. Specimens of *S. rotundifolia* have often been confused with forms of *S. bona-nox*, *S. tamnoides*, *S. walteri*, and *S. glauca* (especially when herbarium specimens of this taxon have had the glaucous underside of the leaf obscured by drying). The latter four species are also sometimes confused with each other as are *S. lanceolata*, *S. smallii*, and *S. auriculata*. This

last species and *S. bona-nox* have also been confused.

During the present study the major effort was placed on searching for new vegetative characteristics and determining which were reliable. It was found that characters involving the leaf margin and submargin are especially valuable and that some charcteristics are usually more evident in dried than in fresh specimens. Specimens with young leaves and a few with apparently intermediate characters, especially between *S. rotundifolia* and *S. bona-nox*, are occasionally difficult to place. Overlapping peduncle lengths may have caused much of the difficulty in the past. Of all the species, *S. rotundifolia* and *S. bona-nox* seem the most closely related and their apparent intergradation seems more a matter of their having been derived from a common ancestor than one of introgression. *S. bona-nox* also seems closely related to certain populations of *S. tamnoides*. I believe that by placing general emphasis on selected vegetative characters the problems of identification of most specimens to species can be solved. The various varieties that have been proposed do not seem tenable with the possible exception of two in *S. tamnoides*.

The petiole as considered below includes that portion of the leaf that also might be interpreted as a strongly constricted base of the blade.

KEY TO SPECIES OF SMILAX

a. Stems hairy; underside of leaves densely hairy; plants trailing, suberect, or low climbing (up to 7 dm); the berries red. 1—S. PUMILA

a. Stems glabrous (rarely with dark stellate hairs on some portions in *S. bona-nox);* underside of leaves glabrous or rarely minutely hairy; plants sometimes erect but usually high climbing; berries red or black (sometimes covered with a bloom). . . . . b

b. Leaves evergreen, thick-coriaceous, oblong to oblong-linear or oblong-lanceolate to rarely broadly linear, on the underside the midvein in its lower third more prominent than the laterals, a lateral vein closely and evenly submarginal (this is more easily seen in dried leaves), the veins indistinct on the upper surface; stigma one; berries black, 1-seeded, ripening late in the second season after flowering in the previous summer or fall. . . . . 2—S. LAURIFOLIA

b. Leaves deciduous or evergreen with leathery to firm-coriaceous but with neither thick nor oblong blades (if oblong, conspicuously veined on the underside), the midvein scarcely or no more prominent than the laterals, with no submarginal vein (unless irregularly spaced along part of the margin—in *S. auriculata)*, the veins sometimes distinct on the upper surface; stigmas 2-3; berries black or red, 1—3-seeded, ripening the same year after flowering in the spring (or the summer of the second year in *S. smallii)*. c

c. Underside of leaves whitened, silvery, or bluish gray; the leaf margins thin though sometimes rolled when dry, not serrulate, and without a rib; berries black or covered with a bloom and bluish; peduncles longer, usually much longer, than the petioles of the subtending leaves. . . . . 3—S. GLAUCA

c. Underside of leaves about the same green color as the upperside; the leaf margins thin or in one species with a rib; berries black or red, rarely covered with a bloom; peduncles longer or shorter than the petioles of the subtending leaves. . . . . d

d. Peduncles 1.5 or more times as long as petioles of the subtending leaves, sometimes to 7 cm long; berries usually 1-seeded. . . . . e

e. Stems with rigid, broad-based, pale, or merely dark-tipped prickles; leaf margins entire or sparsely spinulose-ciliate, and thickened by a marginal rib (often poorly developed in young leaves and in some shade forms), veins and veinlets usually thickened; leaf drying and fading to a tan color. . . . . 4—S. BONA-NOX

e. Stems with relatively weak, somewhat bristle-like, usually dark prickles; leaf margins minutely serrulate and not thickened, veins and veinlets slender; leaf drying and fading to a dull ashy green color. 5—S. TAMNOIDES

d. Peduncles less than 1.5 times as long as petioles of the subtending leaves, or if longer, the stems without dark slender prickles or leaves without a marginal rib, berries 1—3-seeded. . . . . .f

f. Leaves lanceolate to elliptic-lanceolate, smooth margined (use 10X lens), the base broadly cuneate, the apex acute or short acuminate; berries dull red. . 6—S. SMALLII

f. Leaves of an ovate, elliptic, oblong, or suborbicular type; the margin smooth or roughened (use 10X lens); the base rounded to cordate or hastate, rarely abruptly narrowed; the apex notched, mucronulate, cuspidate, acute or obtuse; berries red or black (or bluish black when glaucous). . . . . g

g. Leaves often somewhat hastate, sometimes oblong, conspicuously veined on underside and usually above, with a series of lateral veins which at their extremities are parallel to and within 0.5 mm of margin, the thin margin sometimes inrolled and simulating a marginal rib; petioles of leaves subtending fruits 8 mm long or less; branchlets usually prominently zigzag; berries black. . . . . 7—S. AURICULATA

g. Leaves ovate to ovate-oblong or suborbicular, veins on underside conspicuous or not, without veins parallel to and within 0.5 mm of margin; petioles of leaves subtending fruits over 8 mm long; branchlets usually not zigzag; berries red, black, or bluish black. . . h
h. Berries black (bluish-black when glaucous); principal stems and main branches with stout flattened prickles; leafblades usually ovate; moist or more often dry habitats. . . . 8—S. ROTUNDIFOLIA
h. Berries bright red; stems prickly mostly at the base, the prickles mostly subulate; leaf blades usually ovate-lanceolate; wet habitats. . . . . 9—S. WALTERI

1. SMILAX PUMILA Walt. SARSAPARILLA-VINE

Flowering in late summer and fall, the fruit ripening the next spring and often persisting. (—)

2. SMILAX LAURIFOLIA L. BAMBOO-VINE

An extremely vigorous species with dead as well as live stems often forming impenetrable entanglements. Sometimes confused with *S. smallii* which is also evergreen. In *S. laurifolia* the apex of all but the narrowest leaves is coarsely mucronate and there is a prominent and evenly submarginal vein (more conspicuous when the leaves are dried). In *S. smallii* the apex is acute to shortly acuminate and there is no evenly submarginal vein. In dried leaves of both species the rolled margins may appear like marginal veins or ribs. In *S. laurifolia* the leaf margins are often rolled down in a manner such that there appear to be two closely parallel veins at the margin and in some instances rolled to the extent that there appears to be only one marginal vein (or rib). The leaves are sometimes glaucous beneath. Tex, Okla. (—)

3. SMILAX GLAUCA Walt. SAWBRIER

Plants of this species are often easily recognized in the winter from a distance. Some leaves usually persist, retain their glaucous character beneath, and often turn reddish to purple above. Leaves of specimens that have lost their glaucous character during drying are similar to those of *S. rotundifolia*. In the latter species, however, the internodes of the smallest stems are 4-ridged or 4-angled (and thus quadrangular in cross section) whereas those of *S. glauca* usually are not. In addition, the spines of *S. glauca* are more narrowly longitudinal at their bases. When specimens are sterile and do not include spines on the smallest stems positive identification may not be possible.

Plants with the underside of leaf glabrous (under 10X lens) have been designated as var. *leurophylla* Blake [F, G]. In var. *glauca* the underside

of leaf is covered with minute hairs. Intergradation is such that these taxa do not seem separable. All adjacent states. (28, 32)

4. SMILAX BONA-NOX L. CATBRIER

A scurfy lower portion of the stem is a characteristic feature of this species. This character and the marginal rib, (which is more distinct from the underside of the leaf and when the leaf is dried) help distinguish this species from the sometimes closely similar individuals of other species, especially *S. rotundifolia* and *S. tamnoides*. In dried specimens of these two species the thin leaf margins are sometimes rolled and appear like the marginal ribs on leaves of *S. bona-nox*, *S. rotundifolia* and *S. bona-nox* may often be separated by their fruits, those of the latter usually being 1-seeded and of the former usually 2—3-seeded. *S. tamnoides* may be separated from *S. bona-nox* by the several to many ridges on the stem, the latter having only four ridges. For separating *S. bona-nox* from individuals of *S. auriculata* having similar leaf forms see discussion under the latter species (No. 7). Most of the forms of *S. bona-nox* which are similar to those of the other species are from the Coastal Plain, from Ga to Miss, and in Ark.

Four weakly delimited varieties have been indicated for our area by Fernald. In var. *hederaefolia* (Beyrich) Fern. the leaf blades on fertile branches are green to rarely mottled and cordate-ovate to deltoid-ovate to shallowly panduriform with the margins having few to no cilia. The other varieties [*bona-nox*, *hastata* (Willd.) A. DC., and *exauriculata* Fern.] are characterized by having deltoid to panduriform to narrowly lanceolate blades which have bristly-ciliate margins and are usually mottled with light green. Intergradation is so great that none of the varieties suggested for this species seems tenable. Tex, Okla, Mo, Ill, Ind, O. (32)

5. SMILAX TAMNOIDES L. BRISTLY GREENBRIER

Upon drying, the leaves of this species usually turn light olive-grey in color, whereas those of other species rarely do. Specimens having fiddle-shaped leaves, or nearly so, have often been confused with *S. bona-nox* but lack the marginal ribs on the leaves. The several to many ridges on the stem also serve to distinguish *S. tamnoides*. This latter character is especially useful in separating those forms of *S. rotundifolia* having similar leaf shapes (the latter having only 4 ridges on the stem).

Plants with leaves ovate, elliptic, or nearly orbicular have been designated as var. *hispida* (Muhl.) Fern. [F]. Var *tamnoides*, which is more common in the Coastal Plain, has some or all of the leaves fiddle-shaped. The leaf forms of these varieties intergrade and their distributions overlap. The manner of separation of these two varieties is not clear to me; further study may show that these varieties cannot be maintained. *S. hispida* Muhl. [S]. All adjacent states. (—)

6. SMILAX SMALLII Morong. LANCELEAF GREENBRIER

Leaves are sometimes similar to those of *S. laurifolia* but are thinner. Other distinguishing characters are discussed under the latter species (No. 2). The leaf margins are sometimes rolled down on the underside in dry material and appear much like those forms of *S. bona-nox* having fine marginal ribs. Some forms of *S. smallii* and *S. auriculata* are similar but the latter has a series (rarely only two) of lateral veins which at their extremities are parallel to and within 0.5 mm of the margin of the leaf. Material of this species is frequently used for decoration. *S. lanceolata* L. [S]. Tex, Okla. (—)

7. SMILAX AURICULATA Walt. WILD-BAMBOO

Leaves are usually narrow, sometimes quite narrow, but they may be to 10 cm. wide. On narrow leaves the submarginal veins and the inrolled margin are sometimes so close that along most of the margin they appear as a single rib with a shallow narrow groove. Some individuals of this species are similar to forms of *S. bona-nox* and *S. tamnoides* but are readily separated by having shorter peduncle length and submarginal veins. Forms in southern Fla have a thickened leaf margin or sometimes a rib which may be separated from the submarginal veins only by a groove. These forms intergrade (in Dade, Monroe, and Lee Cos) with *S. havanensis* Jacq. whose leaves have a strong marginal rib which may or may not have spines. Some forms of *S. auriculata* and *S. havanensis* have been unjustifiably assigned to *S. beyrichii* Kunth in the past. SE only. (—)

8. SMILAX ROTUNDIFOLIA L. COMMON GREENBRIER

Various forms of this species have been confused with plants of several other species. The thin leaf margin may be rolled or not. In either case the leaves may be confused with those of *S. tamnoides* (which see for distinguishing characteristics). When the margin is rolled specimens have often been mistaken for *S. bona-nox*. Careful study under at least 10X magnification is suggested in order to distinguish between a true rib and one simulated by the rolling of the thin leaf margin in *S. rotundifolia*.

In the past, forms with four-angled stems have been designated as var. *quadrangulata* (Muhl.) Wood, but I agree with Fernald, Gleason, and others in not recognizing the variety; the smallest stems on almost all plants are quadrangular and there is a complete series of four-angled forms from the least to the most distinctly so. All adjacent states. (32)

9. SMILAX WALTERI Pursh CORAL GREENBRIER

This species is easily separated from the somewhat similar *S. rotundifolia* by a usually different leaf shape and by bright red fruits which are persistent over the winter. Those plants with similar leaf forms are otherwise difficult to separate. When the leaves of *S. walteri* are dried they usually turn to a very lightly orange tinged brown, unlike the color of dried leaves of any other species. Tex, NJ. (—)

ARISTOLOCHIACEAE — BIRTHWORT FAMILY

Woody vines or low perennial herbs.

2174. ARISTOLOCHIA L.

Underside of leaf blades and young stems soft-hairy; calyx yellowish, pubescent; peduncles bractless. . . . . 1—A. TOMENTOSA

Underside of leaf blades and young stems glabrous or minutely pubescent; calyx purple, glabrous; peduncles bearing a rounded cordate bract. . . . . 2—A. MACROPHYLLA

1. ARISTOLOCHIA TOMENTOSA Sims — PIPE VINE

The fruits of this and the following species resemble those of *Yucca*, being a 6-ridged capsule and containing flat seeds arranged in tiers. Escaped from cultivation beyond its natural range. Tex, Okla, Mo, Ill, Ind. (—)

2. ARISTOLOCHIA MACROPHYLLA Lam. — DUTCHMAN'S PIPE

Escaped from cultivation beyond its natural range. *A. durior* Hill [F, G, GC, R, SC]. Pa. (28)

POLYGONACEAE — BUCKWHEAT FAMILY

Trees, shrubs, woody vines, or herbs.

2206. BRUNNICHIA Banks

BRUNNICHIA CIRRHOSA Gaertn. — LADIES' EARDROPS

The common name is derived from the appearance of the winged fruits. Tex, Okla, Mo, Ill. (48)

RANUNCULACEAE — CROWFOOT FAMILY

Shrubs, woody vines, or herbs.

2542. CLEMATIS L.

CLEMATIS VIRGINIANA L. — VIRGIN'S-BOWER, CLEMATIS

The white flowers, usually abundant, are conspicuous even at a distance. Stems are susceptible to winter kill. However, at Athens, Ga, stems survived to 2.5 m above ground with temperature down to 1° F. In the Blue Ridge Province of Va a stem several years old was seen 13 feet above ground (Duncan 22855, ca 2700 feet elevation, Floyd Co). These stems may have survived even colder temperatures. Okla, Mo, Ill, Ind, O, Pa, NJ. (16)

LARDIZABALACEAE — LARDIZABALA FAMILY

Represented in our flora by a woody vine only.

2555. AKEBIA Dcne.

AKEBIA QUINATA (Houtt.) Dcne. — AKEBIA

Rare escape from cultivation, in Madison and Orange Cos, NC only. Native of E Asia. Perhaps escaped in adjacent states. (32)

MENISPERMACEAE — MOONSEED FAMILY

Woody vines.

2567. MENISPERMUM L.

MENISPERMUM CANADENSE L. MOONSEED

Sometimes the petiole may be attached less than one mm inside the edge of the leaf blade and sterile herbarium specimens therefore are sometimes difficult to distinguish from those of *Cocculus*. Only very rarely are the petioles so near the margin on all the leaves of an entire plant. The stone of fruit is flattened on both sides, roughened and grooved, and crescent shaped. Apparently always twines from left to right. All adjacent states. (52)

2570. COCCULUS DC.

COCCULUS CAROLINUS (L.) DC. CAROLINA MOONSEED, CORALBEADS

The bright red fruits are very showy in late summer and fall. The stones, which are flattened on both sides, are shaped somewhat like a snail shell. *Epibaterium carolinum* (L.) Britt. [S]. Tex, Okla, Mo, Ill, Ind. (78)

2599. CALYCOCARPUM Nutt.

CALYCOCARPON LYONII (Pursh) Nutt. CUP-SEED

Stone of fruit hollowed out on one side, making a cup-like depression, its margin roughly ridged. The lack of petals will also serve to separate this species from the sometimes vegetatively similar *Menispermum canadense*. Okla, Mo, Ill, Ind. (—)

SCHISANDRACEAE **SCHISANDRA FAMILY**

Woody vines.

2656. SCHISANDRA Michx.

SCHISANDRA GLABRA (Brick.) Rehd. WILD SARSAPARILLA

Rare but perhaps more common than records indicate. Individual leaves, although alternate, resemble those of the common *Decumaria* and, therefore, may be overlooked. *S. coccinea* Michx. [S]. SE only. (26)

SAXIFRAGACEAE **SAXIFRAGE FAMILY**

Shrubs, woody vines, or herbs.

3222. DECUMARIA L.

DECUMARIA BARBARA L. CLIMBING HYDRANGEA

Trailing as well as climbing. Flowers fragrant, in conspicuous white clusters. SE only. (—)

LEGUMINOSAE **LEGUME FAMILY**

Two genera are woody vines. The other taxa are trees, shrubs, or herbs.

3722. WISTERIA Nutt.

a. Ovary and pod glabrous; leaflets on largest leaves 15 or fewer; calyx tube at anthesis usually longer than wide; auricle of wing-petals linear and nearly parallel to claw. . . . . b

b. Largest leaflets 4-6 cm long, oblong to narrowly elliptic or narrowly ovate, their length-width ratio over 2.2; racemes 4-12 cm long; pedicels and calyx with no to a few (rarely many) stalked glands; auricles of wing-petals shorter than the claw. . . . . 1—W. FRUTESCENS

b. Largest leaflets 5-8 cm long, sometimes smaller in adverse habitats, ovate to elliptic, their length-width ratio under 2.2; racemes 15-30 cm long; pedicels and calyx usually with abundant stalked glands; auricles of wing-petals about as long as the claw. . . . . 2—W. MACROSTACHYA

a. Ovary and pod velvety pubescent; leaflets on largest leaves 7-19; calyx tube at anthesis about as wide as or wider than long; auricle of wing-petals narrowly triangular and divergent 50° or more from the claw. c

c. Leaflets of largest leaves 13-19; flowers gradually opening from base to apex of raceme, the largest racemes 20-50 cm long and 5-7 cm wide; calyx sparsely pubescent outside, broadly cup-shaped, broader than long. . . . . 3—W. FLORIBUNDA

c. Leaflets of largest leaves 7-13; flowers opening nearly simultaneously, the largest racemes 15-20 cm long and 8-10 cm wide; calyx densely pubescent outside, campanulate, the tube about as broad as long. . . . . 4—W. SINENSIS

1. WISTERIA FRUTESCENS (L.) Poir. WISTERIA

This species seems distinct from the next over large areas but the two intergrade locally and in the western part of our area. Intergradation seems to have been mostly promoted by frequent use of these species as ornamentals. Treating the two taxa as varieties does not seem justified by my studies to date. Additional studies of the populations are especially needed west of the Mississippi River. Such studies may indicate a varietal status for the two taxa whereas it is not indicated for the populations to the east. *Kraunhia frutescens* (L.) Britt. [S]. Tex. (16)

2. WISTERIA MACROSTACHYA Nutt. WISTERIA

Apparently favored over the above species for planting because of its longer racemes. It has escaped and hybridized with *W. frutescens*. See discussion above. *Kraunhia macrostachya* (Nutt.) Small [S]. Tex, Okla, Mo, Ill, Ind, O. (16)

3. WISTERIA FLORIBUNDA (Willd.) DC. JAPANESE WISTERIA

Native of Asia. Cultivated and escaped. *Kraunhia floribunda* (Willd.) Taub. [S]. Tex. (16, 24)

4. WISTERIA SINENSIS Sweet CHINESE WISTERIA

Native of Asia. Cultivated and frequently escaped. SE only. (16)

3889. PUERARIA DC.

PUERARIA LOBATA (Willd.) Ohwi KUDZU-VINE

Flowering abundantly but fruiting infrequently. Leaves and younger

stems highly sensitive to frost but older stems, sometimes those high in trees, resistant to the coldest winters in the southern states. Introduced from E Asia and now abundantly naturalized. Often used for erosion control but now mostly detested. Climbing to the tops of tallest trees and often destroying forest areas. *P. thunbergiana* (S. & Z.) Benth. [S]. Tex, Mo, Ill, O. (22, 24)

ANACARDIACEAE **SUMAC FAMILY**

Trees, shrubs, or woody vines.

4594. TOXICODENDRON [Tourn.] Mill.

TOXICODENDRON RADICANS (L.) Kuntze POISON IVY

Main stem to 10 cm diameter. A rare form of this species has five leaflets. Also grows as a low, slender, unbranched to weakly branched shrub. Many persons are highly allergic to contact with any part of plants of this species. Repeated washings with abundant use of soap followed by rinsings are strongly recommended as a preventive measure if one suspects, or has had, contact with any part of a plant. *Rhus radicans L.* [F, G. GC, R, SC]. All adjacent states. (30)

CELASTRACEAE **STAFFTREE FAMILY**

Trees, shrubs, or woody vines.

4625. CELASTRUS L.

CELASTRUS SCANDENS L. BITTERSWEET

The globose fruits when ripe are orange and split open into 3 valves exposing the fleshy scarlet coverings around the seeds. Fruiting branches, stripped of leaves, are often used for interior decoration. A specimen collected by T. G. Harbison and reported to be from White Sulphur Springs, Meriwether Co., Ga. is undoubtedly from Greenbrier Co., W. Va. I have seen a collection of *Acer pennsylvanicum* by Harbison from White Sulphur Springs, W. Va. made only one day earlier. The label is in Harbison's own handwriting. It would seem that the *Celastrus scandens* was mislabeled, especially since the Georgia locality in question is south of the expected range of the species. All adjacent states. (46)

RHAMNACEAE **BUCKTHORN FAMILY**

Trees, shrubs, or woody vines.

4868. BERCHEMIA Neck.

BERCHEMIA SCANDENS (Hill) K. Koch RATTAN-VINE, SUPPLE-JACK

Main stems have been seen as large as a diameter of 18 cm. *B. scandens* (Hill) Trelease [S]. Tex, Okla, Mo, Ill. (—)

VITACEAE **GRAPE FAMILY**

Most individuals are woody vines. Some are fleshy vines or shrubby. Four genera have species which are woody vines.

4909. VITIS L.

Since grapes have some plants with staminate flowers only, a practical taxonomic treatment should utilize vegetative characters in so far as possible. From the discussion below it should become evident that for other reasons also it is necessary to rely heavily on vegetative characters.

In the early years of my observations on grapes, fruit size seemed to be a very useful character. The closely related *V. rotundifolia* and *V. munsoniana* were traditionally separated mostly on fruit size. Also, of the remaining species it seemed that there were species whose fruits were large *(V. labrusca, V. mustangensis, V. shuttleworthii)*, that those of *V. aestivalis* were medium-sized, and that still others were relatively small *(V. cinerea, V. vulpina, V. riparia, V. rupestris, V. palmata)*, although within the groups fruit size had practically no diagnostic value. Subsequent field and herbarium studies showed that the fruits did not serve to separate the first two species and that there was considerable overlap between the "medium-sized" fruits of *V. aestivalis* and certain species in both the large and small fruited groups. Presently, fruit size seems to be of relatively little value since the large-fruited species can readily be recognized by the nature of the vestures on the lower leaf surface.

Other fruit characters are also of limited value in separating closely related species. However, in *V. riparia* the fruits are generally glaucous while in the related *V. vulpina* and *V. palmata* they generally are not. Also on plants in the same region the fruits of the former usually ripen before those of *V. vulpina* while those of *V. palmata* usually ripen later than either of the other two species. In addition, the shape and surface features of the seeds may be different in *V. vulpina* from those in *V. riparia*. The same general problems are often involved in respect to fruit flavor and texture of most species of grapes. Further study is needed to establish the reliability of each of the above characters over the entire ranges of the species.

The usefulness of inflorescence length is essentially limited to separation of the taxa into two artificial groups. Inflorescences are relatively short in some species *(V. rotundifolia, V. mustangensis, V. labrusca,* and *V. shuttleworthii)* and considerably longer in all other species except *V. rupestris* in which they are generally only slightly longer. The number and density of fruits in the inflorescences of otherwise closely similar species are usually not correlated with other characters. At least one exception occurs in those elements of *V. vulpina* that have permanently hairy leaf undersurfaces. Such individuals usually occur in the Coastal Plain and most often have more numerous and crowded fruits than the more glabrous forms of any area.

In my studies of vegetative characters it soon became evident that the

interpretation of some species as presented by current manuals needed modification. Not only was there some disagreement among current authors concerning characteristics of certain taxa but as data from increasing numbers of specimens became available it was seen that intergradation of certain characters was such that some taxa probably should not be maintained at any level. A notable example existed in the case of *V. baileyana.* The characters attributed to this species by S, F, G, and others fail to correlate so frequently and intergrade so abundantly in a continuous series with characters of *V. vulpina* that only one taxon is justified. Combining the individuals of these species into one taxon, *V. vulpina,* means that the leaves of this species vary from glabrous to short hairy and/or sometimes cobwebby.

V. cinerea var. *floridana* also has been variously delimited. In any combination, however, many of the characters intergrade abundantly with those of the new *V. vulpina* (above), especially in the Coastal Plain from Va to Ala. Therefore, I have concluded that many specimens that have been labeled as this variety of *V. cinerea* are part of a highly variable *V. vulpina,* and that some are parts of the variable *V. aestivalis* and *V. cinerea.* In *V. vulpina* the number of individuals with abundant short spreading and/or cobwebby hairs in general increases southwardly; the same is true for *V. aestivalis.* For example, to the north, especially beyond our range, and south in the Blue Ridge into Ala many individuals, and in some places all, have glabrous leaves, whereas with increasing distances from these areas the density of cobwebby hairs on plants in general increases until leaves and stems are often heavily beset with them. Plants with abundant cobwebby hairs are most frequent in the southern part of the Coastal Plain. In *V. aestivalis* the cobwebby hairs are much more abundant than in *V. vulpina.* The reverse is true of the short spreading hairs. These short hairs may predominate, especially in *V. vulpina,* or may be accompanied by the cobwebby hairs which sometimes obscure them. Some of these hairy forms of *V. aestivalis* are the *V. simpsonii* and *V. rufotomentosa* as treated by Small. Fernald and Gleason interpreted *V. simpsonii* as being *V. cinerea* var. *floridana.* However, intergradation of *V. simpsonii* and *V. rufotomentosa* with *V. aestivalis* of the older sense is continuous and complete. It is important here to note that the "straight" hairs of *V. aestivalis* (of my interpretation) are longer and usually more rusty or reddish than in *V. cinerea.* The hairs are usually greyish or ashy in the latter species.

Recently I have decided that *V. lincecumii* is not taxonomically distinct from *V. aestivalis.* None of the characters used diagnostically by various authors seems reliable. However, those populations formerly designated as *V. lincecumii,* which are largely west of the Mississippi River, generally have leaves that are less whitened beneath, i.e., there

are fewer plants with heavily glaucous leaves and more plants with leaves merely light green beneath.

Combining the various taxa as indicated above reduces to ten the number of species in our area. As may be deducted from the presentation to follow, further combinations may need to be made, but if so, probably only to the subspecies or varietal level. Although some of the ten species as treated here do intergrade, the numbers of intermediate individuals are relatively small and are sometimes apparently absent over large areas. Additional information concerning the species and their relationships should be helpful in understanding species variability, in use of the key to follow, and in placing plants in the appropriate species, and is presented below.

V. labrusca and *V. shuttleworthii* are closely related, having several similar characteristics including that of the vesture on the leaf. The felty hairs of these species lie very close to the lower leaf surface. These hairs may have some relation to those of *V. mustangensis* or densely cobwebby ones of forms of *V. aestivalis*, many of which have been misnamed as *V. labrusca*. The vesture types of *V. mustangensis* and *V. aestivalis*, however, are distinguishable in that the cobwebby hairs extend farther from and do not lie as close to the leaf surface. The types of vestures on *V. mustangensis* also are quite similar to those on some forms of *V. cinerea*. Nevertheless, individuals of the two species are usually readily distinguishable, the cobwebby hairs in the former consisting of a felty mat and in the latter being distinctly less abundant. A few intermediates indicate natural hybridization occurs between these two species.

Intergradation between *V. cinerea*, *V. aestivalis*, and *V. vulpina* is probably more abundant than between other species combinations. The most important situations seems to be as follows. Some individuals of the latter two species have spreading hairs characteristic of *V. cinerea*. Cobwebby hairs of forms of *V. cinerea* and/or of *V. aestivalis* sometimes occur on leaves of *V. vulpina*, and the types of hairs on *V. cinerea* and *V. aestivalis* occasionally intergrade. Individuals of *V. vulpina* that seem to be influenced by hybridization with the other two species usually exhibit larger leaves with broader shoulders in addition to a greater abundance of cobwebby hairs. Intergradation involving *V. cinerea* and *V. vulpina* most often occurs in Ky, W Tenn, or Ala and westward while that involving *V. aestivalis* and *V. vulpina* is most abundant in the southern part of the Piedmont, and in the Coastal Plain from SC to Fla, and in Ark. In spite of similarities between some individuals of these three species and the occurrence of intermediates the combination of short spreading hairs on the leaves, petioles, and stems of the current year serve to identify individuals of *V. cinerea* while the light colored to heavily glaucous surface (hair color is excluded) of the

underside of the leaves and often more lobing serve to distinguish *V. aestivalis* from *V. vulpina* whose leaf blades are greenish beneath. The younger leaves may cause confusion because some maturation is required before the light (or glaucous) surface is clearly evident, especially in dried specimens.

The type of loose cobwebby hairs that is characteristic of the lower and sometimes upper sides of the leaves of *V. mustangensis* is occasionally found on leaves of *V. cinerea,* more frequently west of the Mississippi River but occasionally eastward to central Tenn. This type of hair is also found on some leaves of *V. aestivalis* west of the Mississippi River and eastward in the lower Coastal Plain into eastern Fla.

V. vulpina, V. riparia, V. palmata, and *V. rupestris,* all of which have leaf blades greenish beneath, form a natural group. The lateral lobes of the leaves generally are the most prominent in *V. palmata* and least prominent (and sometimes absent) in *V. vulpina* and *V. rupestris.* Leaf blades of all four species generally average less in width than blades of plants in sympatric populations of *V. cinerea* and *V. aestivalis.*

Increased lobing of leaves is apparently associated with certain environmental situations and specimens consisting of a stem and a few leaves may be atypical of the species. Sprouts arising after earlier growth has been cut down (such as by mowing and cutting along highway rights of way) generally have leaves that are more prominently lobed. This same situation may occur after fire has killed or damaged the earlier growth. Under such circumstances leaves of *V. vulpina* which ordinarily are often unlobed are shaped like small editions of lobed forms of *V. aestivalis* or *V. palmata.* Leaves produced later in the growing season often have more prominently lobed leaves anyhow, but the differences are generally not as great as under the above circumstances. Lobing of the leaves, however, may be quite characteristic of many populations. In some, especially in southern Coastal Palin populations of *V. aestivalis* and *V. shuttleworthii,* the leaves are always lobed and sometimes deeply so.

Caution should be taken in respect to the interpretation of the extent of hairiness of *Vitis* plants. Hairs present on young parts may later fall off and so the time of year that the collection was made or the plant is being observed should be considered. Sometimes the first nodes and internodes may be hairy, even permanently so, and yet the upper nodes and more often the internodes are glabrous or eventually become so. Therefore, the part of the plant which is being observed should be considered.

Studies of grapes from the horticultural viewpoint may have contributed considerably to the recognition of the many species and varieties which appeared in literature in the past. In more recent manuals some of the taxa have been combined, apparently on the basis of studies

of greater numbers of specimens. On the basis of specimens seen from over 36 herbaria, I have decided that further combinations are needed and am reducing the number of species in the southeast to ten. It also seems that none of the commonly recognized varieties should be maintained. Additional studies are needed to learn whether or not all ten species should be maintained at that level. Some of the problems involved will be evident in the treatment to follow.

KEY TO SPECIES OF VITIS

a. Bark not shredding; lenticels evident on older stems; tendrils simple; pith without diaphragms at the nodes; berries 10-25 mm in diam, in globular or slightly elongate bunches; fully expanded leaves dentate, unlobed to shallowly lobed, glabrous beneath except axils of veins and sometimes on the veins. . . . 1—V. ROTUNDIFOLIA

a. Bark on the older stems shredding; lenticels inconspicuous or absent; tendrils usually forking; pith with diaphragms at the nodes; berries 3-25 mm in diam, usually in elongated bunches; fully expanded leaves dentate to serrate, scarcely to deeply lobed, glabrous to quite hairy beneath. . . . . b

b. Underside of fully expanded leaves felty with densely and evenly matted white, ashy grey, tawny, or rusty cobwebby hairs, these hairs *evenly* distributed and concealing the surface but not always the larger veins, very small parts of the leaf surface sometimes being visible under 10X magnification. c

c. Underside of leaves with short spreading hairs hidden beneath a very closely adhering mat of cobwebby hairs which may be separated with a needle from the shorter straight hairs, all hairs being light grey, La and Ala. 4—V. MUSTANGENSIS

c. Underside of leaves with no short spreading hairs or such hairs not hidden beneath the mat of cobwebby hairs which adhere tightly to the leaf surface, hairs white to rusty-colored. . d

d. A tendril and/or inflorescence at each of 3 or more consecutive nodes; the hairs on the underside of leaves tawny to reddish. . . . . 2—V. LABRUSCA

d. A tendril and/or inflorescence at no more than 2 consecutive nodes; the hairs on the underside of leaves white to reddish. . . . . 3—V. SHUTTLEWORTHII

b. Underside of fully expanded leaves not felty, but glabrous or with short spreading or cobwebby hairs or both, the hairs not concealing the surface (sometimes densely cobwebby but then the surface of the hair-mass uneven and small areas of the leaf surface visible through "windows" in the matted hairs). . . . . e

e. STEMS of current year, PETIOLES, and UNDERSIDE OF LEAVES with light-colored (sometimes tawny-) short spread-

ing hairs, the longest on the petioles and underside of leaves being about 0.20 mm long. . . . . 6—V. CINEREA

e. STEMS of current year usually lacking short spreading hairs (sometimes the nodes and the basal few internodes with short spreading hairs), PETIOLES usually without short spreading hairs (the hairs, if present, from about 0.20 to 0.35 mm long), UNDERSIDE OF LEAVES glabrous or with short spreading hairs to 0.35 mm long. The few hairy forms of *V. vulpina* which may not be readily separated from *V. cinerea* by the above characters may be distinguished by their smaller leaves with less prominent (or no) shoulders. . . . . f

f. Underside of fully expanded leaves not greenish, the surface either glaucous (and then glabrous or hairy) or light-colored and bearing light to rusty-colored cobwebby hairs—or sometimes also with short spreading light- to rusty-colored hairs); usually some or all leaves lobed and with rounded sinuses; young stems, petioles, and peduncles glabrous or often with cobwebby hairs, or less frequently with straight hairs or both; the older stems of the current year rarely with the nodes or the basal few internodes bearing short straight hairs. . . . . 5—V. AESTIVALIS

f. Underside of fully expanded leaves greenish (never glaucous) and glabrous except in axils of main veins, or sometimes with scattered cobwebby hairs and/or short spreading hairs (in forms of *V. vulpina);* leaves usually unlobed or if lobed the base of the sinus angled, usually acute, or rarely rounded in sprouts after cutting or burning; young stems, petioles, and peduncles glabrous (in forms of *V. vulpina* with short spreading hairs and/or occasionally with thin cobwebby hairs). . . . . g

g. Leaves usually broader than long, when fully expanded mostly 3-10 cm long and 4-12 cm wide; peduncles 7-20 mm long, not bearing a tendril; the bark tardily exfoliating; mostly prostrate, or trailing or rarely climbing; tendrils often scarce (sometimes absent).
. . . . . 8—V. RUPESTRIS

g. Leaves usually longer than broad, when fully expanded mostly 5-20 cm long and 6-18 cm wide; peduncles 15-80 mm long, often bearing a tendril which often falls easily but leaves a scar; the bark usually exfoliating by the end of the second year; plants high climbing; tendrils usually several to many. . . . . h

h. Leaves unlobed or with short-pointed or shoulder-like lateral lobes that are sometimes stubbily falcate,

the margins usually not ciliolate, most or all serrations obtuse as determined by straight lines from the sinuses to the outward edge of the serration but omitting any cusp present; in many forms the underside of the leaves with short straight hairs and/or rarely cobwebby ones; diaphragm of pith usually 2-6 mm long; fruit black, usually not glaucous.
. . . . . 7—V. VULPINA

h. Leaves usually with two tapering lateral lobes that are erect to slightly divergent, the leaf margins ciliolate or eciliolate, most or all serrations acute; leaves rarely hairy beneath; diaphragm of pith 0.8-5 mm long; fruit black and not glaucous, or heavily glaucous. i

i. Branches of current season green, gray, or brown after leaves are mature; diaphragm of pith 0.8-2 mm long; mature leaves firmly membranaceous, the margins ciliolate, the tip acute to short-acuminate; fruit black to deep purple under a glaucous surface. . . . . 9—V. RIPARIA

i. Branches of current season bright red or purplish-red after leaves are mature; diaphragm of pith 2-5 mm long; mature leaves thin, the margins eciliolate or nearly so, the tip long acuminate to tapered; fruit black, not glaucous
. . . . . 10—V. PALMATA

1. VITIS ROTUNDIFOLIA Michx.
MUSCADINE, SCUPPERNONG, BULLACE GRAPE

Leaf blades vary from kidney-shaped to cordate-deltoid and the tip rounded to acuminate. Forms occurring in the scrub vegetation of central Fla have largest leaves only 3 cm wide. Fruits are variable in size (1-2.5 cm), texture of skin and flavor. Plants with the smaller fruits, more tender skin, and acid pulp are frequent in peninsular Fla and have been segregated as *V. munsoniana* Simpson but seem not taxonomically distinct. At the very most the two might be varieties. Two types of domestic grapes originated from this species. Those with amber-green fruits are known as Scuppernongs while those with purple fruits are Muscadines. Both wild and domestic forms frequently send out drooping aerial roots from the stems, a character that seems peculiar to this species of grape. *Muscadinia rotundifolia* (Michx.) Small [S]. *Muscadinia munsoniana* (Simpson) Small [S]. Tex, Okla, Mo. (40)

2. VITIS LABRUSCA L. FOX OR PLUM GRAPE

Strains of the cultivated *V. labruscana* Bailey have occasionally escaped, sometimes in areas where *V. labrusca* is not native. However,

since these cultivated strains originated from the latter, they are being treated here under *V. labrusca*. The berries are usually from 15-25 mm in diameter. This species is closely related to *V. shuttleworthii* which occurs only in Fla. Cobwebby forms of *V. aestivalis* have frequently been confused with *V. labrusca*. Some specimens with young leaves are especially hard to place. On older leaves of the latter, however, the felty hairs are evenly and tightly adhered to the under leaf surface, whereas in *V. aestivalis* some portions of the cobwebby hairs are in irregular masses slightly raised above the leaf surface. Mo, Ill, Ind, O, Pa, NJ. (38)

3. VITIS SHUTTLEWORTHII House — UPLAND GRAPE

Much like the preceding species but the hairs on the underside of the leaf blades may vary from white to rusty-colored, especially when young. Leaves with white hairs sometimes occur on the same plant with leaves having rusty hairs. The blades may be unlobed to deeply 5-lobed. The berries are 15 mm in diam or less, and variable in size. Small may have considered rusty-colored forms as part of *V. simpsonii* Munson. *V. coriacea* Shuttlew. Fla only. (—)

4. VITIS MUSTANGENSIS Buckl. — MUSTANG GRAPE

The leaves are sometimes deeply lobed as they are in *V. shuttleworthii*. The hairs on the underside of the leaves are always light in color. The cobwebby hairs on the stems are mostly longitudinally oriented. This species may be related to both *V. labrusca* and *V. cinerea*. In some forms of the latter the character of the vesture is much like that of *V. mustangensis* but less dense. These two species are also readily distinguished in that the leaf serrations on larger leaves in the latter are wider apart (ca 10 mm) than in *V. cinerea* (ca 5 mm). *V. candicans* Engelm. Tex, Okla. (38)

5. VITIS AESTIVALIS Michx. — SUMMER OR PIGEON GRAPE

A quite variable and widely distributed species. The undersurface of the leaf is pale or glaucous though sometimes almost hidden by hairs. The light color is sometimes faint on young leaves, particularly in dried specimens. The petioles and first year stems as well as the underside of the leaves are sometimes cobwebby, especially in Fla and the lower Atlantic Coastal Plain. The hairs are quite rusty in "scrub" habitats. In "scrub" areas of central Fla the largest leaves may not exceed 4 cm in width. The petioles and veins on the underside of the leaves sometimes have a few to rarely many short spreading hairs (such plants may also have cobwebby hairs). These spreading hairs are usually longer than those of *V. cinerea*, the longest being about 0.35 mm long in the former and 0.20 in the latter. Where the two taxa are sympatric the leaves of *V. aestivalis* are usually the larger. Some forms are much like *V. cinerea* except that the stems lack short spreading hairs. Sometimes the first few nodes and internodes may have spreading hairs. Forms with no

spreading hairs on any part of the plant to those forms with many such hairs on one or more parts sometimes occur in the same populations.

In *V. aestivalis* all types of hairs tend to be less rusty-colored and are more often grey in the western part of our area as compared to the eastern. The percentage of plants with rusty-colored hairs and the color-intensity and density of these hairs increase into the southeastern-most part of our area. Plants having reddish to rusty cobwebby hairs and few to no spreading hairs on the underside of the leaf are widely distributed and have been treated as var. *aestivalis* [F]. These are the most abundant in the Lower Coastal Plain and especially in peninsular Fla. Those plants with the hairs mostly or entirely early deciduous or absent have been known as var. *argentifolia* (Munson) Fern. [F, G, GC, R] or *V. bicolor* LeConte [S]. These are the most abundant in the Blue Ridge and other mountains to the west and north of our area. Plants from La to Fla with permanently hairy twigs and petioles have been separated as *V. rufotomentosa* Small [S] and those with dense rusty tomentum on the leaves as *V. simpsonii* Munson [S]. Varied combinations of characters have been used to separate *V. lincecumii* Buckl. [F, G, S] but largely on the basis of bigger berries and a more cobwebby underside of the leaf blade. As is partly indicated in the introductory discussion on *Vitis* the characters used to separate the above taxa intergrade abundantly and in varying combinations. From the data presently available it seems that none of them should have separate status. However, there is justification for extensive studies designed to determine whether or not any of those formerly treated as species should be recognized at the subspecific level. Studies are also necessary to determine more clearly the relationships existing between *V. aestivalis, V. cinerea,* and *V. vulpina* which intergrade and apparently hybridize. All adjacent states. (38)

6. VITIS CINEREA Engelm. DOWNY OR SWEET WINTER GRAPE

The hairs on plants of this species are usually light-colored but occasionally vary to rufescent. Var. *floridana* Munson [F, G, GC] (*V. simpsonii* Munson as interpreted by F and G, but not S) has been separated as having rufescent or rusty hairs, but intergradation of color and other characters is such that this variety should not be maintained. Specimens previously assigned to this variety and from Fla and Ga to Va are usually forms of *V. vulpina* while those from Miss and W Tenn and westward occasionally are forms of *V. cinerea.* Some individuals previously assigned to *V. cinerea* but not having spreading hairs on all internodes probably are forms of *V. aestivalis* or *V. vulpina,* or are introgressants or hybrids of *V. cinerea* with these species. Although *V. cinerea* intergrades with these species, the three species should be maintained. (See introduction to *Vitis* and under *V. aestivalis* for discussions of the intergradation and separation of these species.) *V. cinerea* sensu R seems to

involve some individuals of *V. aestivalis* as well. A collection of *Vitis* from Calcasieu Parish, La (Thieret 23510. Section 39. Just west of Calcasieu River. Ca 5.5 miles SE of Sulphur) is tentatively being assigned to *V. cinerea*. These plants are extremely glaucous, often chalky, with even the second year stems usually being chalky. Additional study is needed, especially of material from west of our range. *V. baileyana* Munson [SC in part]. Tex, Okla, Mo, Ill, Ind, O. (38)

7. VITIS VULPINA L. FROST GRAPE

In the Coastal Plain this species is the most frequent in lowlands but in the higher provinces it frequently inhabits upland situations. Petioles and the underside of leaves often have short spreading hairs and/or sometimes cobwebby ones. Such plants are the most abundant in the Coastal Plain, and especially in Fla and Ala and westward. Most of these plants formerly have been interpreted as being *V. cinerea* var. *floridana* or *V. baileyana*. (See the introduction to *Vitis* for discussions regarding combination of these taxa.) Some of the hairy plants formerly included in the latter two taxa are probably intergrades of *V. aestivalis* and *V. cinerea*. Forms of *V. vulpina* with glaucous fruits usually show some intergradation with *V. aestivalis* or *V. riparia*. *V. vulpina* and *V. riparia*, although usually distinct, have forms that may be confused. Ordinarily in the former the leaf blades are unlobed, or the lobes, if present, are unlike the central one, the teeth, excluding any cusp, are obtuse, and the margins usually not ciliate. The seeds of *V. vulpina* are generally longer than broad and usually acuminate, the raphe extending over the end as an elevated ridge. See *V. riparia* for contrasting characteristics. *V. vulpina* often develops deeply lobed leaves after cutting or burning of older stems. *V. cordifolia* Lam. [S]. *V. baileyana* Munson [SC in part, S, F, G, R]. All adjacent states. (38)

8. VITIS RUPESTRIS Scheele SAND OR SUGAR GRAPE

Occurs mostly in rocky situations along and in streams. This species seems related to *V. riparia*. Its often shrubby nature may be partly due to lack of something to climb on rather than to hereditary factors. Studies are needed to determine whether or not both taxa should be maintained and if so, at what level. Okla, Mo, O, Pa. (38)

9. VITIS RIPARIA Michx. RIVERSIDE GRAPE

The most frequent in the more moist habitats, as the common name implies. Separated from *V. vulpina* by having lateral lobes of leaves usually like the central one, leaf margins ciliolate, teeth of leaves acute (see couplet h in key), the seeds commonly rounded and with an obtuse apex, the raphe extending over the end only as a line. Sometimes the leaves are similar to those of *V. vulpina* in that the blades are unlobed or have lobes characteristic of that species. The unlobed leaves are often the first formed of the year, those being formed later in the year usually having the more distinctive lateral lobes. In W Va, Ky, and Ark indi-

viduals of these two species are often similar in that *V. riparia* frequently has short lateral lobes, but the ciliolate margins and acute serrations of the leaves usually identify the latter.

Some leaves of *V. riparia* are similar to those of *Ampelopsis cordata.* The latter may be identified by its having stems with a white pith while that of *Vitis* species is light brown. *V. vulpina* L. [S]. Tex, Okla, Mo, Ill, Ind, O, Pa. (38).

10. VITIS PALMATA Vahl. RED OR CAT GRAPE

This species generally is found in habitats that are more moist than those in which *V. riparia* occurs. The leaf-lobes of this species are longer and more tapered than those of the related *V. riparia.* Tex, Okla, Mo, Ill, Ind. (—)

4915. PARTHENOCISSUS Planch.

PARTHENOCISSUS QUINQUEFOLIA (L.) Planch.
VIRGINIA CREEPER, WOODBINE

Those plants with twigs, tendrils, and leaves pubescent instead of glabrous have been considered as a separate species, *P. hirsuta* (Donn.) Small [S] and a form [F, G]. All adjacent states. (40)

4916. AMPELOPSIS Michx.

a. Leaves compound. . . . . b
b. Leaves bipinnately or partially tripinnately compound; leaflets many. . . . . 1—A. ARBOREA
b. Leaves palmately compound, leaflets 3 and 5. . . . . 4—A. ACONITIFOLIA
a. Leaves simple. c
c. First year stem glabrous, leaf blades usually not lobed. . . . . 2—A. CORDATA
c. First year stem pubescent, sometimes almost glabrous near end of year, leaf blades usually lobed. . 3—A. BREVIPEDUNCULATA

1. AMPELOPSIS ARBOREA (L.) Rusby PEPPER-VINE

A collection from Cabell Co., W. Va. may be planted, for collection data report "climbing over shrubs and trees in Roland Park." Tex, Okla., Mo, Ill. (40)

2. AMPELOPSIS CORDATA Michx.

Leaves similar to those of some *Vitis* but this species has a white pith in the stems while that of *Vitis* is light brown. Tex, Okla, Mo, Ill, Ind, O. (40)

3. AMPELOPSIS BREVIPEDUNCULATA (Maxim.) Trautv.

Uncommon escape from cultivation, then often rampant. Native of Asia. *A. heterophylla* Sieb. & Zucc. [S]. O, Pa. (—)

4. AMPELOPSIS ACONITIFOLIA Bunge.

Not illustrated.

A native of N China. In alluvial woods, Orange Co., N. C. Apparently persisting or an escape from planting by Mr. F. J. le Clair in the for-

mer nursery of the Soil Conservation Service SE of Chapel Hill. Soil Conservation records indicate that the original source was from the Nursery of the Plant Introduction Station, U. S. Department of Agriculture, Glendale, Maryland. SE only. (—)

4918. CISSUS L.

CISSUS INCISA (Nutt.) Des Moulins MARINE-VINE, MARINE IVY

Main stems to 21 cm diam. Tex, Okla, Mo. (—)

PASSIFLORACEAE **PASSION-FLOWER FAMILY**

Woody vines or herbs.

5372. PASSIFLORA L.

PASSIFLORA PALLIDA L. PASSION-FLOWER

Branches are susceptible to winter kill in N part of range. *P. suberosa* L. Fla only. (12, 24, 36)

ARALIACEAE **GINSENG FAMILY**

Trees, woody vines, or herbs.

5855. HEDERA L.

HEDERA HELIX L. ENGLISH IVY

Leaves evergreen. Plants often trailing. A native of Europe. Frequently cultivated and rarely escaped, apparently by vegetative means. Mo. (48, 96)

ERICACEAE **HEATH FAMILY**

Shrubs, trees, or woody vines.

6200A. PIERIS D. Don

PIERIS PHILLYREIFOLIA (Hook.) DC. CLIMBING HEATH

Unique in climbing in crevices of bark or beneath outer bark of *Taxodium ascendens*. It also climbs *Pinus* but rarely, at least once has been noted climbing Titi (presumably *Cyrilla* or *Cliftonia)* in the vicinity of St. Andrews Bay (apparently Bay Co., Fla), and often grows as a shrub. *Ampelothamnus phillyreifolius* (Hook.) Small [S]. SE only. (—)

LOGANIACEAE **LOGANIA FAMILY**

Woody vines or herbs.

6447. GELSEMIUM Juss.

Flowers fragrant; length-width ratio of largest leaf blades 2.9-5.1; body of fruit 14-23 mm long and 8-11 mm wide; seeds winged.
. . . . . 1—G. SEMPERVIRENS

Flowers usually not fragrant; length-width ratio of largest leaf blades 1.0-3.9; body of fruit 9-12.5 mm long and 5.5-8 mm wide; seeds not winged. . . . . 2—G. RANKINII

1. GELSEMIUM SEMPERVIRENS (L.) Jaume Saint-Hilaire
YELLOW JASMINE

Most often of upland habitats. Density and size of stomates may be used to separate this species from the following should identification of sterile material be important. Duncan* found that in *G. sempervirens* the stomates averaged from 20-34 per .0926 sq. mm, 25-37 μ long, and 19-26 μ wide, whereas in *G. rankinii* the values were 34-46, 18.5-26 μ and 13.5-19 μ. Leaves of the previous year of this and the following species are often all shed by sometime in the summer, especially in the more northern parts of their ranges. Therefore, it may then be difficult to determine whether or not the leaves are evergreen. Under these circumstances separation of *Gelsemium* plants by this character from sterile material of *Trachelospermum difforme* may be difficult. However, plants of *Gelsemium* may be distinguished from those of *Trachelospermum* by the absence of stipules on petioles. Small narrow stipules are present at the very base of the petioles of the latter. The stipules often fall from older leaves. Tex. (16)

2. GELSEMIUM RANKINII Small SWAMP YELLOW JASMINE

Confined to wet habitats. Generally flowering later than *G. sempervirens*. SE only. (8)

APOCYNACEAE **DOGBANE FAMILY**

Trees, shrubs, woody vines, or perennial herbs.

6667. TRACHELOSPERMUM Lemaire

TRACHELOSPERMUM DIFFORME (Walt.) Gray
CLIMBING DOGBANE

Flowers quite fragrant. Tex, Okla, Mo, Ill, Ind. (—)

ASCLEPIADACEAE **MILKWEED FAMILY**

Perennial herbs or woody vines.

6733. PERIPLOCA L.

PERIPLOCA GRAECA L. SILK VINE

Native of Europe. Known as escape in Knox Co., Tenn. (22, 24)

6797A. CYNANCHUM L.

CYNANCHUM SCORPARIUM Nutt. CYNANCHUM

Mostly herbaceous in the northern part of its range. Often almost leafless as season progresses, but then usually conspicuous because of abundant branches. Similar to the herbaceous *Seutera maritima* Decne. *Amphistelma scoparium* (Nutt.) Small [S]. SE only. (—)

BIGNONIACEAE **TRUMPET CREEPER FAMILY**

Trees or woody vines.

7705. ANISOSTICHUS Bureau

ANISOSTICHUS CAPREOLATA (L.) Bureau CROSS-VINE

Cross sections of the stem reveal a cross-shaped pith, hence the common name. The large tubular corollas are orange-yellow outside and

yellow within. *A. crucigera* (L.) Bureau [S]. *Bignonia capreolata* L. [F]. Tex, Okla, Mo, Ill, Ind, O. (40)

7714. CAMPSIS Lour.

CAMPSIS RADICANS (L.) Seem. TRUMPET CREEPER, COW-ITCH

The large tubular corollas are scarlet or reddish outside. Some persons are quite allergic to plants of this species. *Bignonia radicans* L. [S]. All adjacent states. (40)

CAPRIFOLIACEAE HONEYSUCKLE FAMILY

Shrubs, woody vines, or herbs.

8523. LONICERA L.

a. Flowers and fruits 2 (or by abortion one) on peduncles in leaf axils; leaves all separate from each other, the blades sometimes lobed. . . . . 1—L. JAPONICA

a. Flowers and fruits in terminal clusters; uppermost leaves, especially those below the flowers and fruits, united around the stem (connate), the blades never lobed. . . . . b

b. Corolla 35-55 mm long, rarely shorter (as short as 20 mm in one form), slenderly trumpet-shaped, the lobes nearly equal. . . . . 2—L. SEMPERVIRENS

b. Corolla less than 35 mm long, not as slender, 2-lipped, the upper lip broad and 4-lobed, the lower narrow. c

c. Uppermost connate leaves in an orbicular to oval form, with emarginate to obtuse ends, the upper as well as lower side glaucous; corolla pale yellow. . . . . 3—L. PROLIFERA

c. Uppermost connate leaves in a more elongate form, usually obtuse to acute at ends, the upperside green or lightly glaucous; corolla orange-yellow, rarely pale yellow (if so, at least partly tinged with purple or shades of red). . . . . d

d. Underside of leaf blades glaucous; corolla 15-25 mm long, the tube stout and enlarged on one side within one mm of the base, the lobes purplish or reddish. . 4—L. DIOICA

d. Underside of leaf blades light green or pale to lightly glaucous; corolla 20-37 mm long, the tube slender with no enlargement at base (some with a slight enlargement a few mm above the base), the lobes yellow or orange. . . . . 5—L. FLAVA

1. LONICERA JAPONICA Thunb. JAPANESE HONEYSUCKLE

This species, mostly undesirable, was introduced from Asia. Plants with branchlets and leaves purple and glabrous instead of green and pubescent, and with the corolla lobes united ½ or less and more reddish outside than var. *japonica* have been distinguished as var. *chinensis* (P. W. Wats.) Baker [F]. Intermediate forms seem so abundant that the

two varieties probably cannot be maintained. All adjacent states. (18)

2. LONICERA SEMPERVIRENS L. CORAL-HONEYSUCKLE

This species is frequently used as an ornamental and has escaped. This may partly account for some of the more scattered records to the north. Var. *sempervirens* which has the upperside of leaves, hypanthium, and outside of the corolla glabrous is widespread. In the more restricted var. *hirsutula* Rehd. [F, G] these parts are hairy and/or glandular. Plants with corollas 2-3 cm long have been described as var. *minor* Ait. [F]. *Phenianthus sempervirens* (L.) Raf. (S). Tex, Okla, Mo, Ill, Pa, NJ. (18, 36)

3. LONICERA PROLIFERA (Kirchn.) Rehd.

This taxon is closely related to and intergrades with *L. dioica* and may not be separable from it, especially at the species level. Var. *glabra* Gleason with leaves glabrous beneath seems not separable from var. *prolifera* with leaves hairy beneath. *L. sullivantii* Gray [S]. Okla, Mo, Ill, Ind, O. (18)

4. LONICERA DIOICA L. LIMBER HONEYSUCKLE

L. glaucescens Rydb. [S] has been separated from this species by having the underside of leaf blades and outside of the corolla pubescent instead of glabrous. Some authors [F, G, GC] have reduced this to a variety of *L. dioica*. Other varieties have also been proposed [F, G, GC]. Further study is needed but only one taxon seems justified since characters intergrade over a wide area as well as form different combinations. Okla, Mo, Ill, Ind, O, Pa. (—)

5. LONICERA FLAVA Sims. YELLOW HONEYSUCKLE

L. flavida Cockerell [S, F]—which has also been treated as var. *flavescens* (Small) Gleason [G] and is separated on the basis of having a shorter corolla tube, a lighter colored corolla, and more hairy within—intergrades frequently with this species and is thought not to be separable. *L. flava* and *L. dioica* intergrade in the Arkansas area.

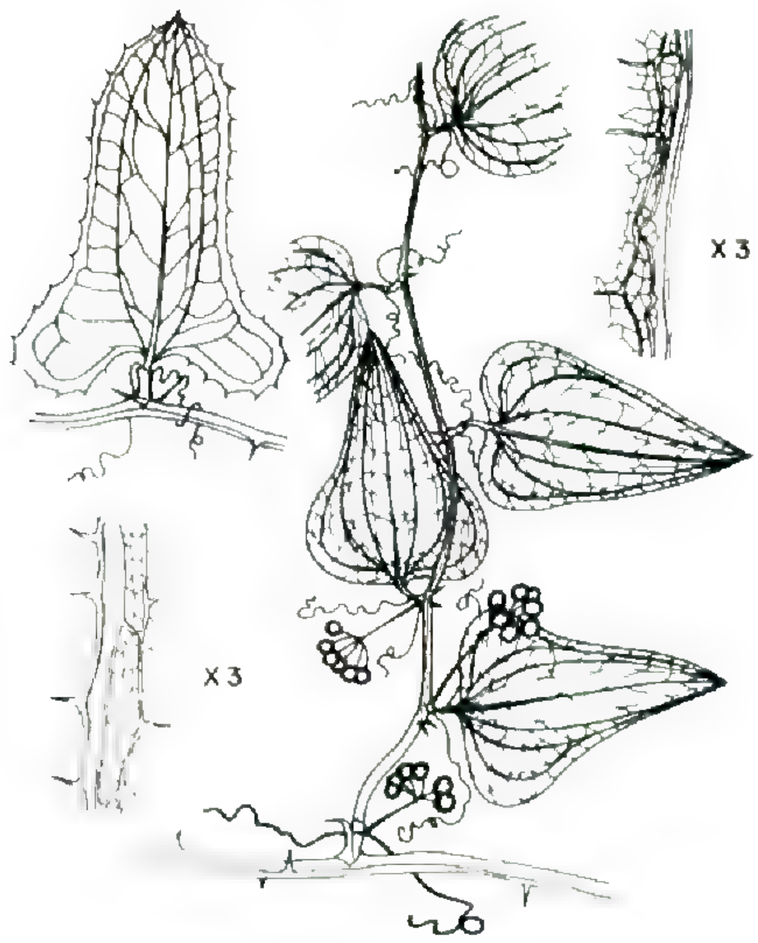
In the Ark area and in Ala (rarely) some plants have the corolla tube enlarged beginning a few to several mm from the base instead of at it. The illustration of *L. flava* in Gleason is of a specimen of this kind (from Montier, Shannon Co. in central-south Mo). Enlargement of the corolla tube some distance above the base may indicate relationship to some western element, perhaps *L. ciliosa* (Pursh) Poiret which also has a prominently enlarged tube several mm from the base. Further study is needed to determine whether or not those individuals in Ark and Ala having the corolla tube enlarged away from the base might be more appropriately placed with some far western taxon. The possibility should be considered that those individuals of *L. flava* (in the present sense) having the corrolla enlarged at the base and some far western species such as *L. ciliosa* are varieties or subspecies of the same species. Okla, Mo, Ill. (—)

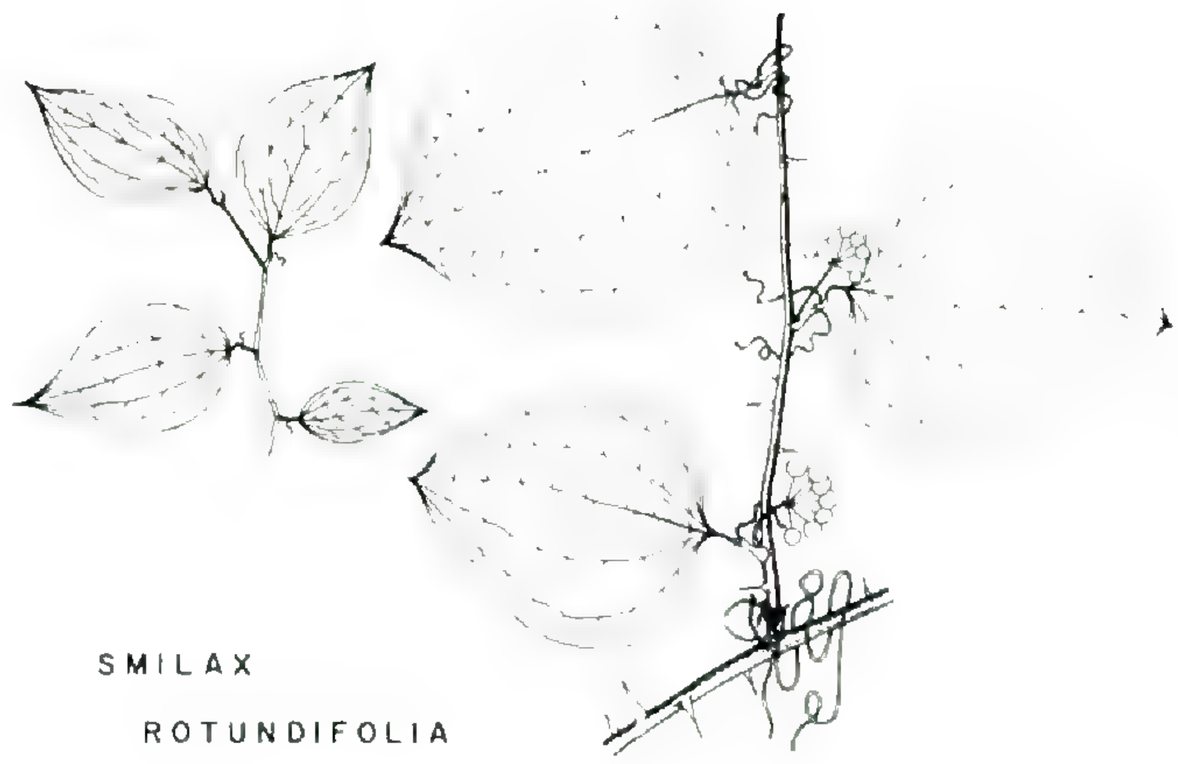
APPENDIX

Specimens examined in this study were from herbaria as follows.

Academy of Natural Sciences, Philadelphia, Pa.
University of Alabama
Braun, E. Lucy, Cincinnati, Ohio
Carnegie Museum, Pittsburgh
University of Cincinnati, Ohio
University of Delaware
Duke University, N. C.
Emory University, Ga.
Florida State University
University of Florida
Georgia Southern College
University of Georgia
Gray Herbarium, Mass.
Indiana University
University of Kentucky
Longwood College, Va.
University of Louisville, Ky.
Lynchburg College, Va.
University of Maryland
University of Mississippi
New York Botanical Garden
North Carolina State University
University of North Carolina
Shorter College, Ga.
Southern Methodist University
University of Southern Mississippi
University of Southwest Louisiana
University of Tennessee
Tulane University, La.
United States National Arboretum
United States National Herbarium
Valdosta State College, Ga.
Vanderbilt University, Tenn.
Virginia Polytechnic Institute
West Virginia University
University of Wisconsin

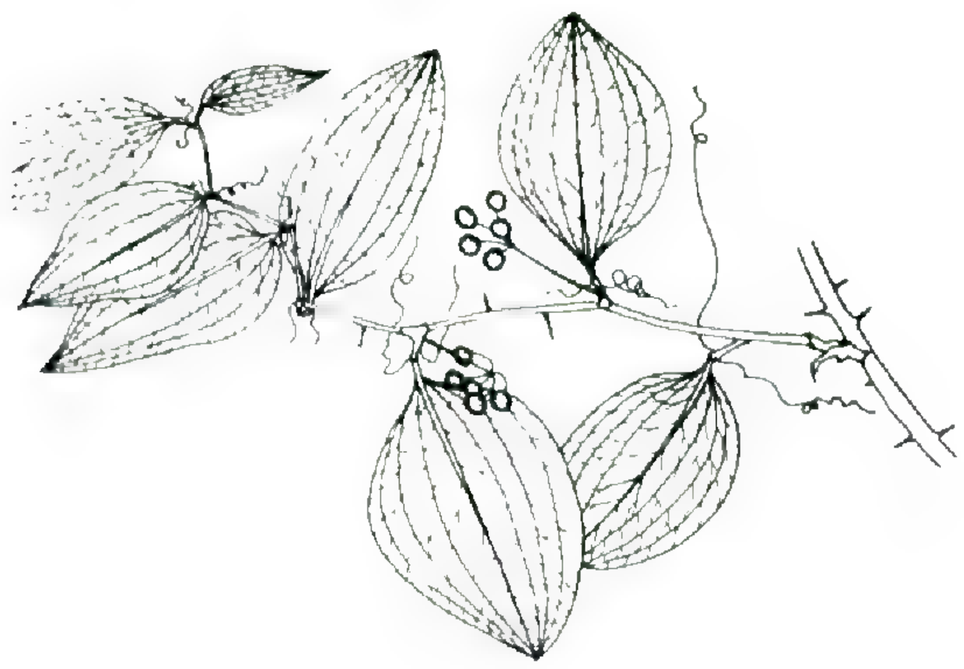
SMILAX BONA-NOX





SMILAX
ROTUNDIFOLIA

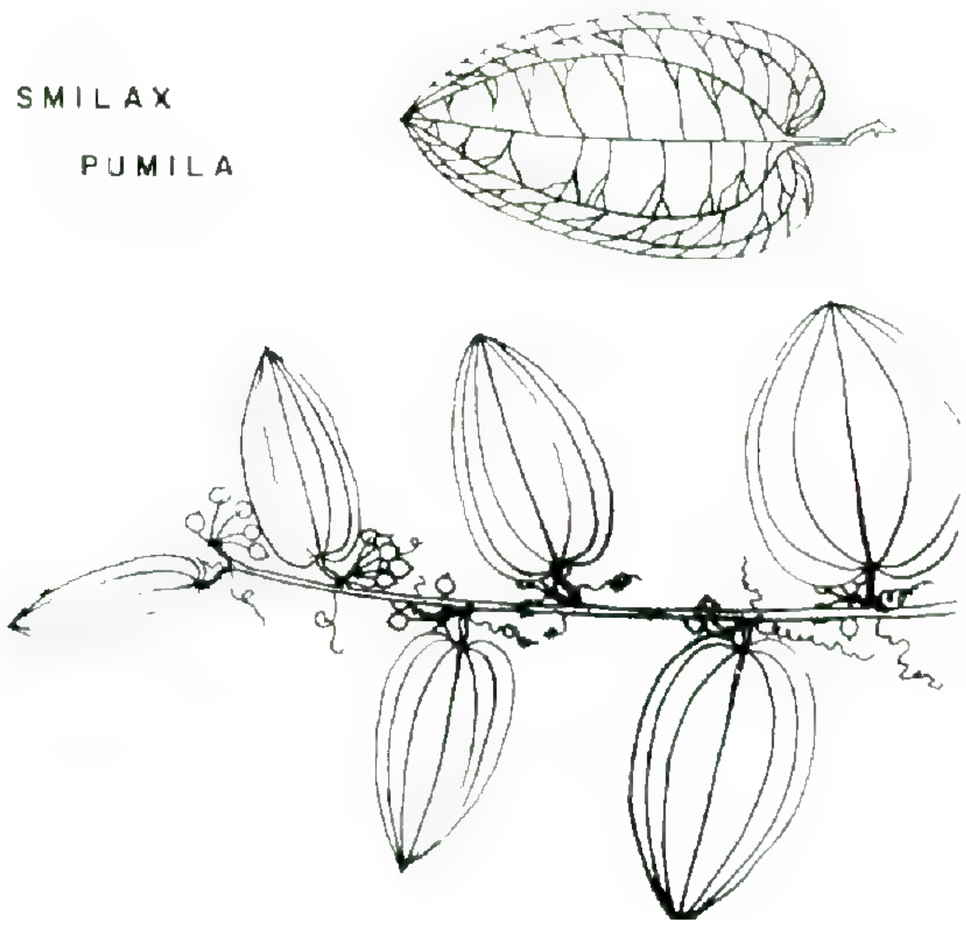
SMILAX GLAUCA



SMILAX AURICULATA

SMILAX LAURIFOLIA

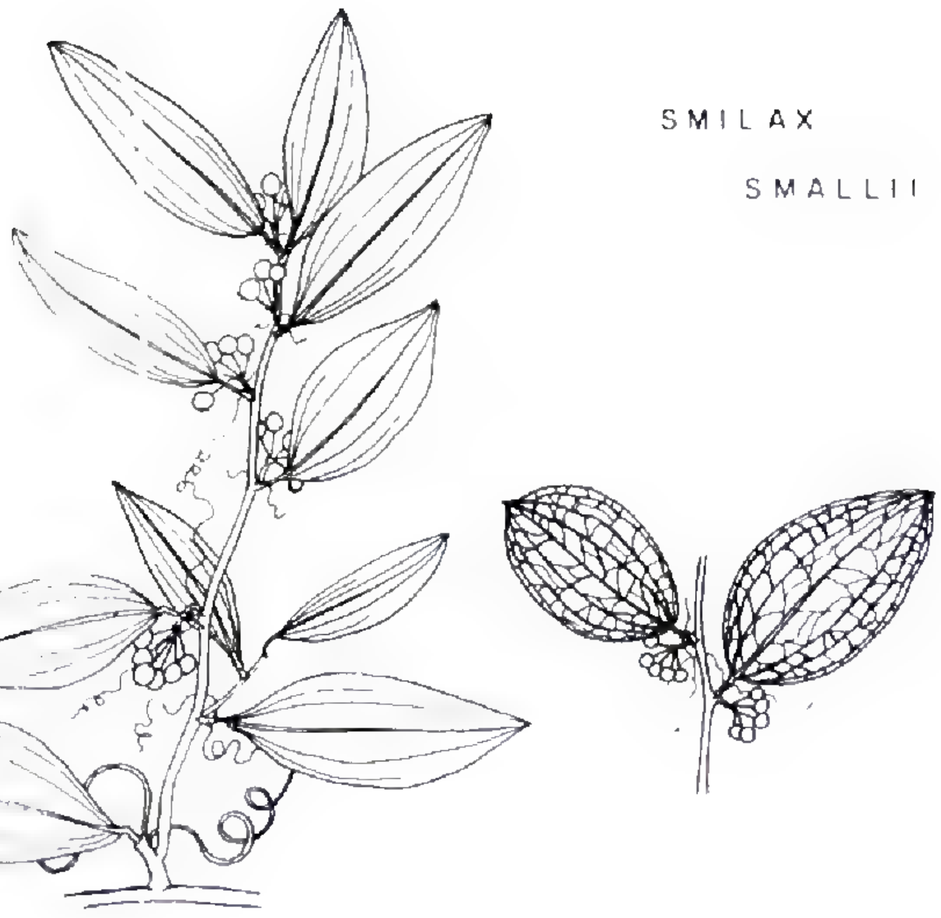
SMILAX
PUMILA



SMILAX

WALTERI

ARISTOLOCHIA TOMENTOSA



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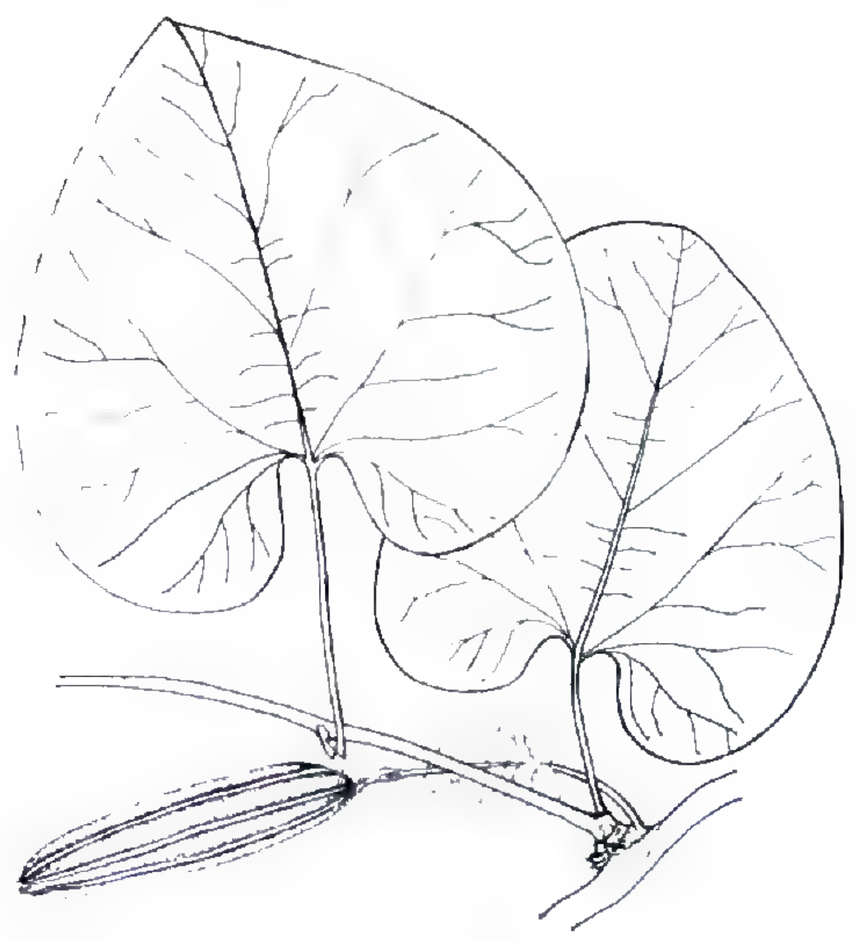
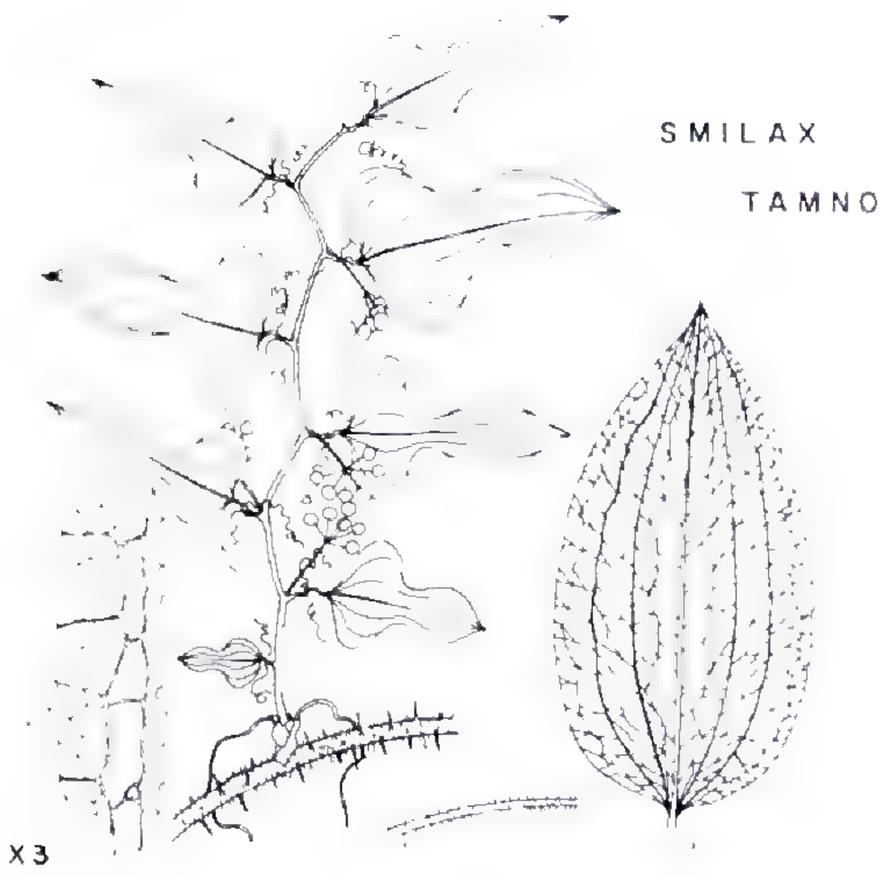
SMALLII



ARISTOLOCHIA MACROPHYLLA



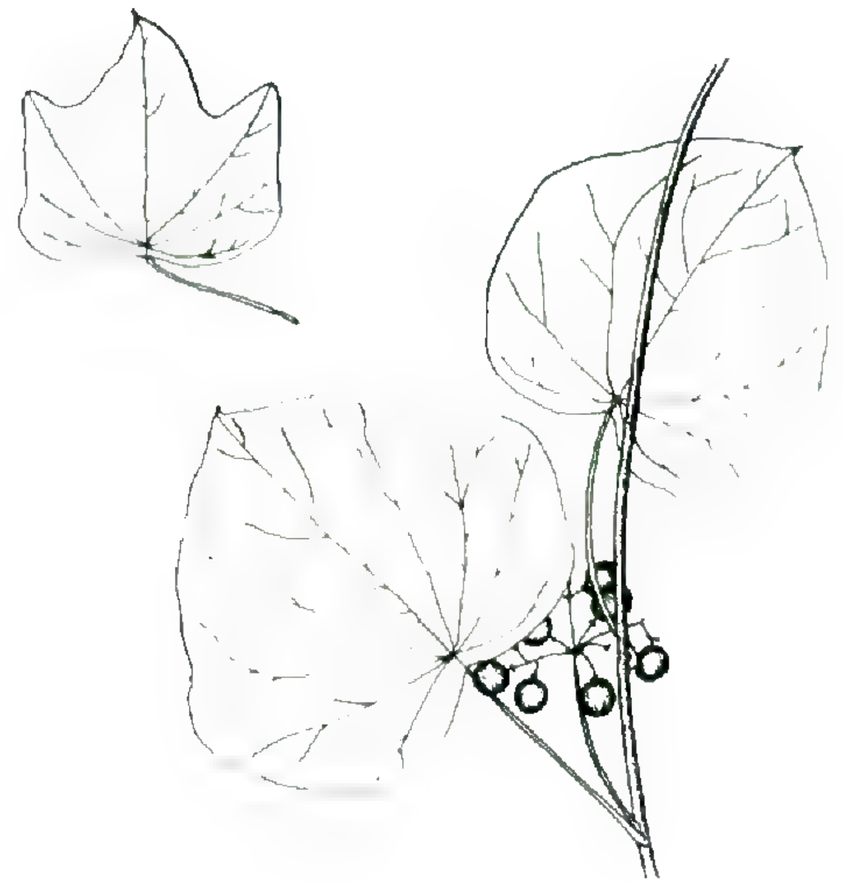
SMILAX

TAMNOIDES

X3

BRUNNICHIA CIRRHOSA

MENISPERMUM CANADENSE

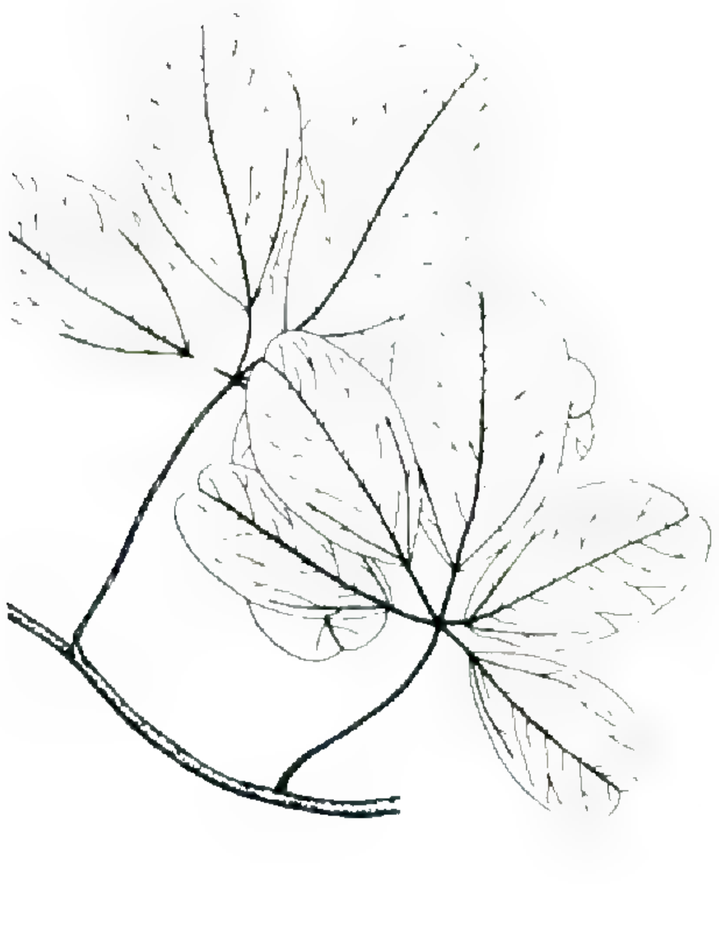


COCCULUS CAROLINUS

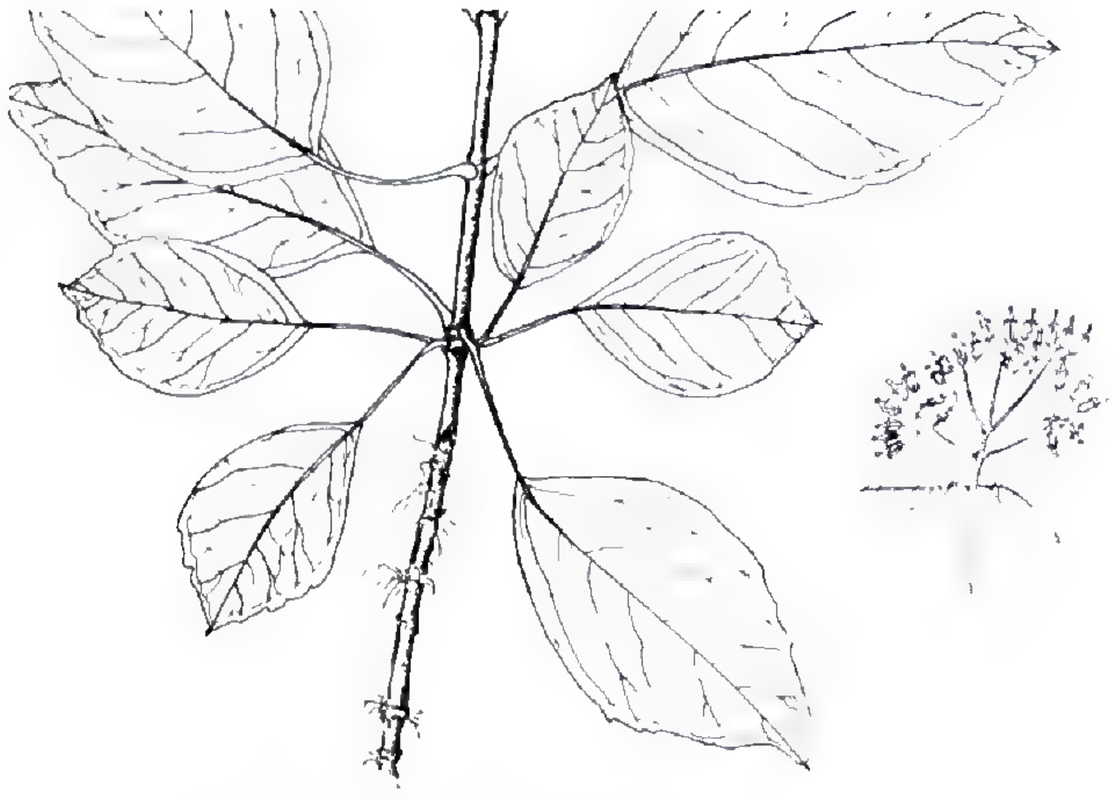
CLEMATIS
VIRGINIANA

SCHISANDRA
GLABRA

AKEBIA QUINATA

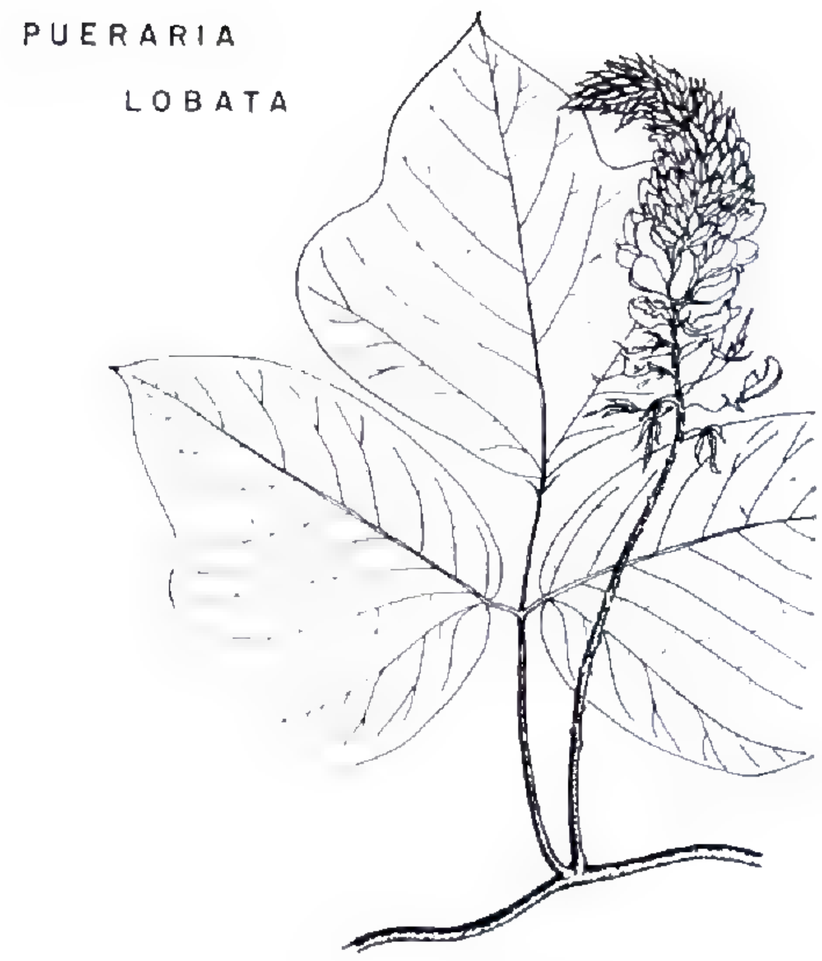


CALYCOCARPON LYONII



DECUMARIA BARBARA

PUERARIA LOBATA



WISTERIA FLORIBUNDA

WISTERIA FRUTESCENS

WISTERIA SINENSIS

WISTERIA MACROSTACHYA

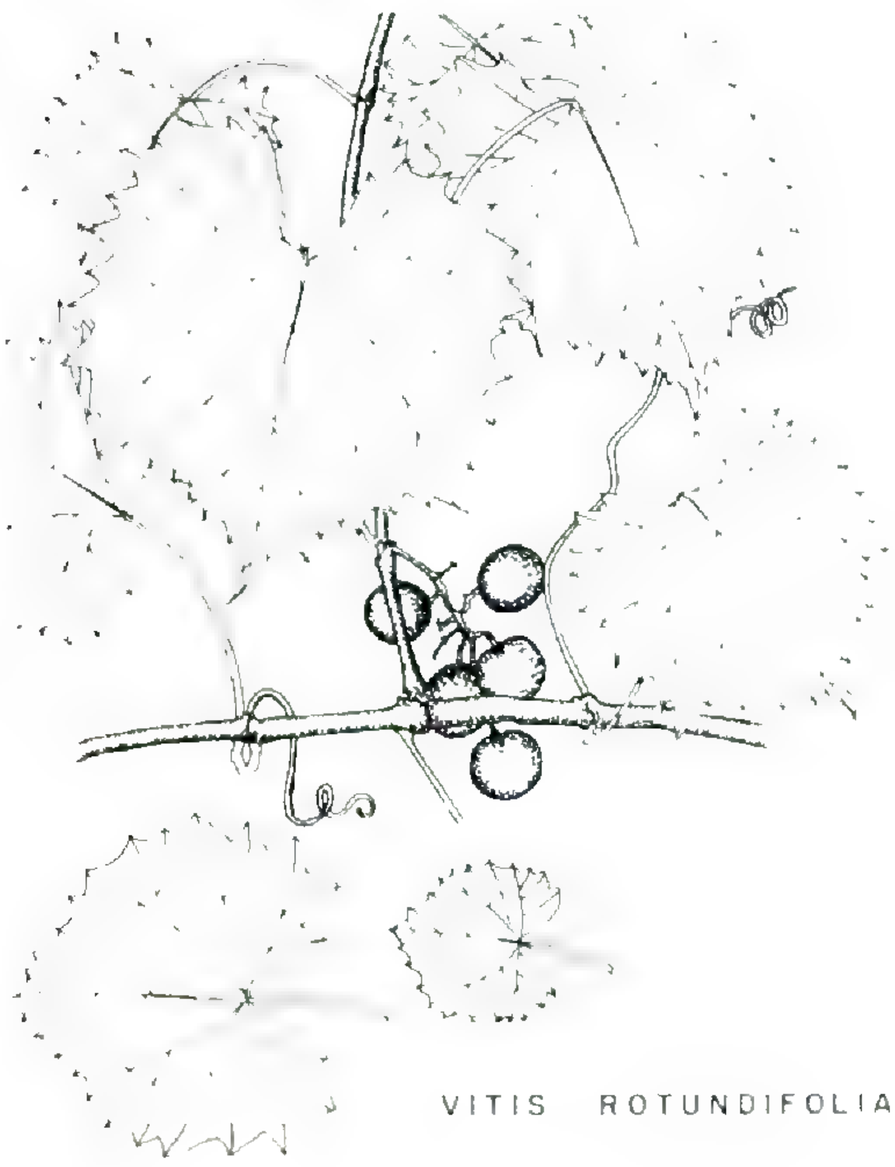
BERCHEMIA SCANDENS

TOXICODENDRON RADICANS

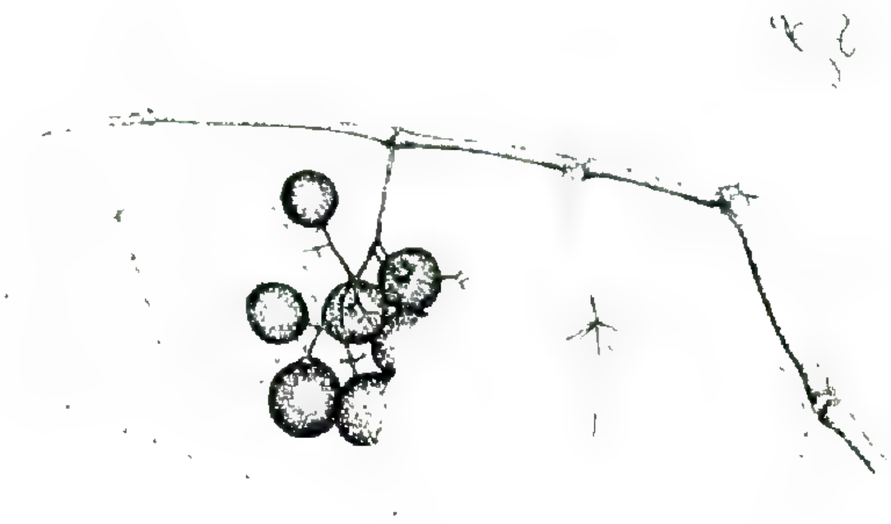
CELASTRUS SCANDENS

VITIS LABRUSCA

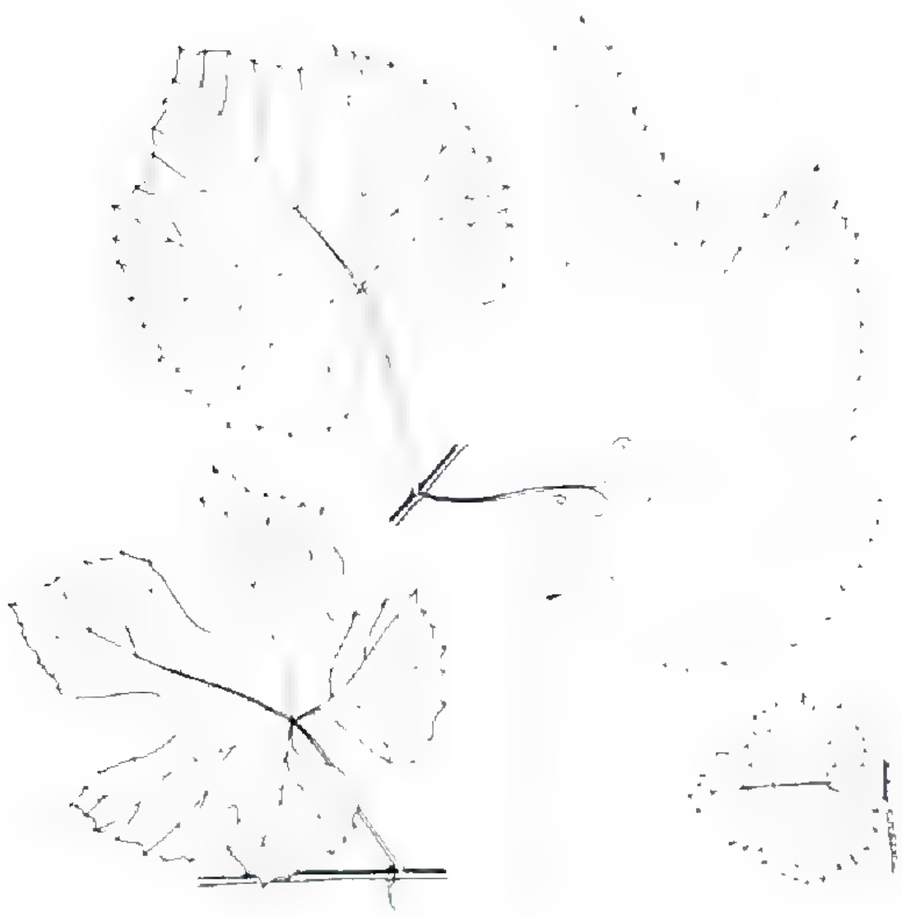
VITIS ROTUNDIFOLIA

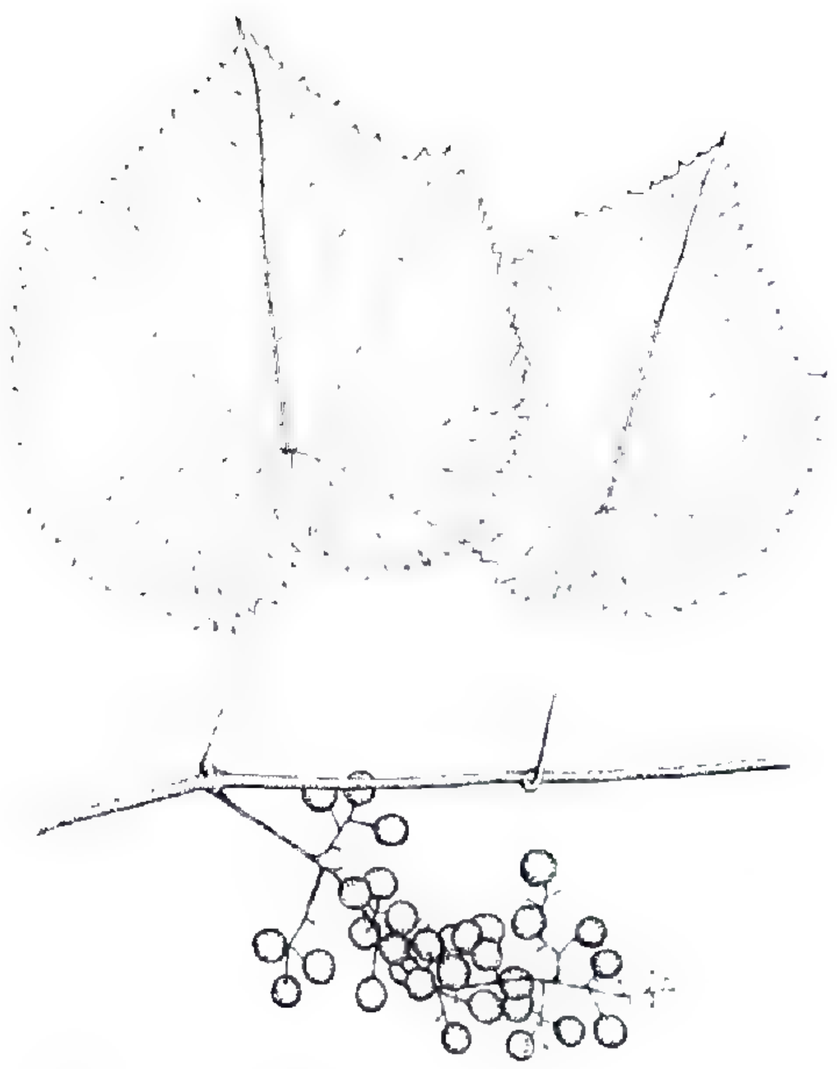


VITIS MUSTANGENSIS



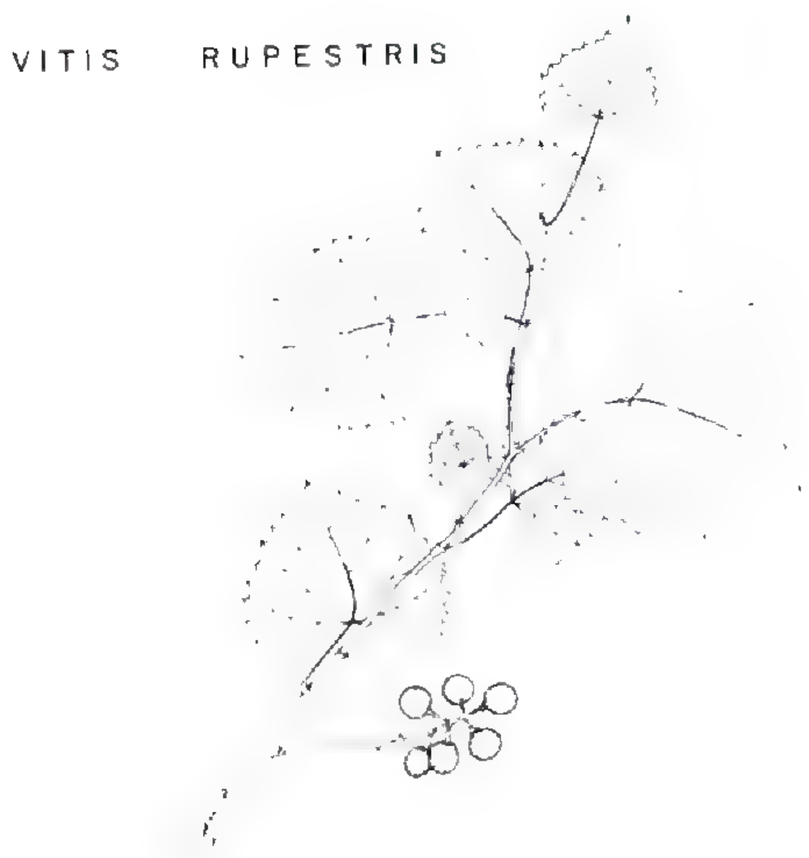
VITIS AESTIVALIS





VITIS CINEREA

VITIS RUPESTRIS



VITIS RIPARIA

VITIS VULPINA

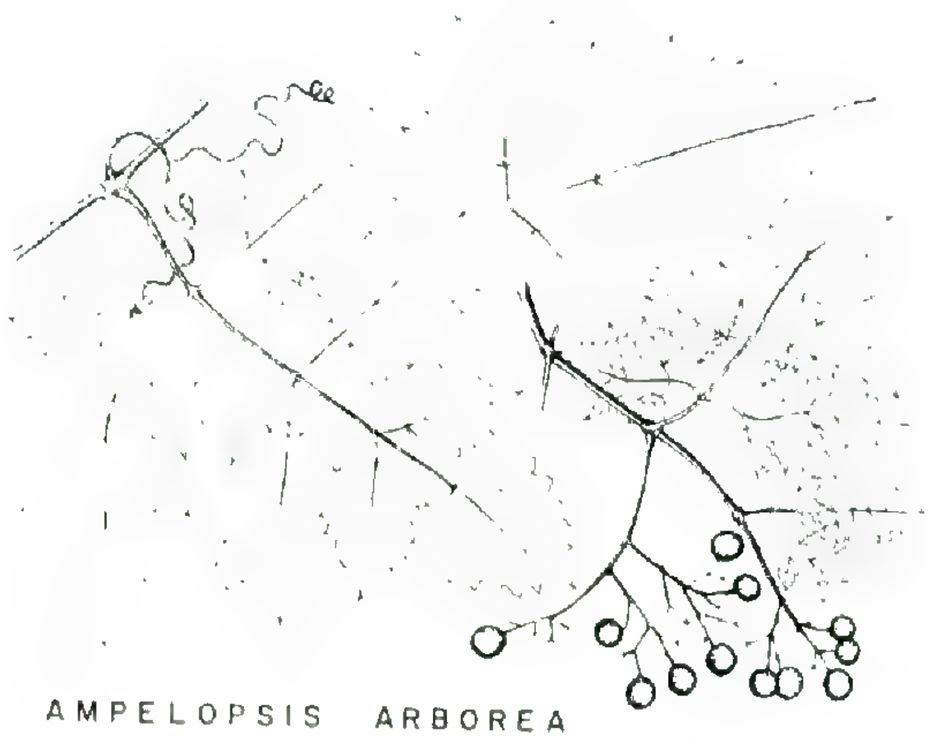
VITIS SHUTTLEWORTHII

VITIS PALMATA

AMPELOPSIS CORDATA

CISSIS INCISA

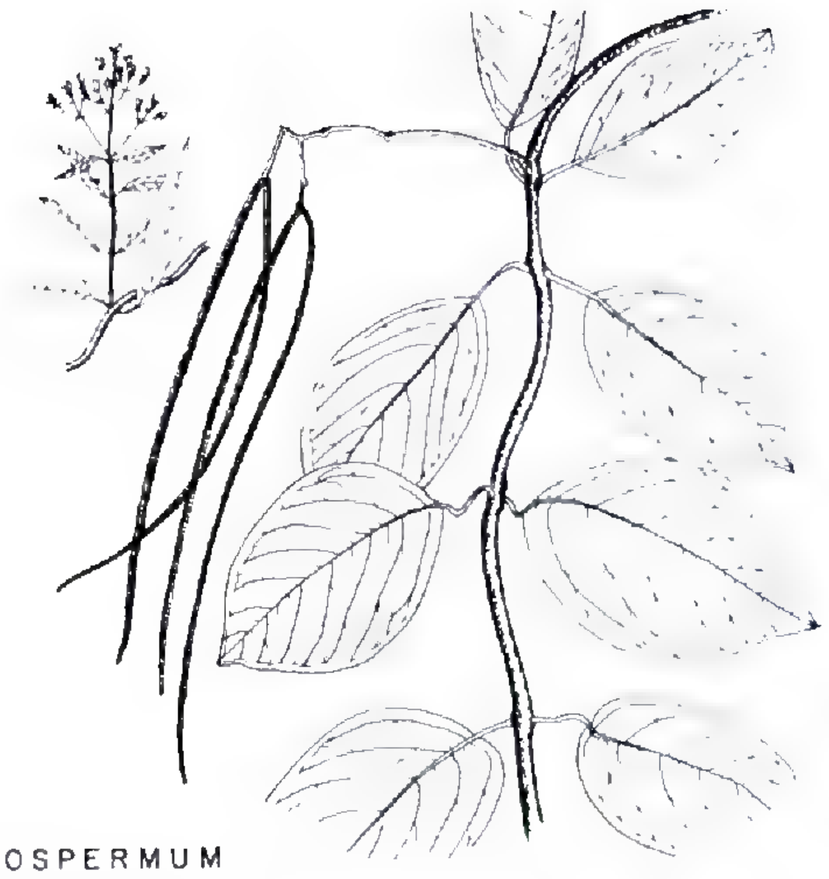
AMPELOPSIS ARBOREA



AMPELOPSIS BREVIPEDUNCULATA

PARTHENOCISSUS QUINQUEFOLIA

PASSIFLORA PALLIDA



TRACHELOSPERMUM
DIFFORME

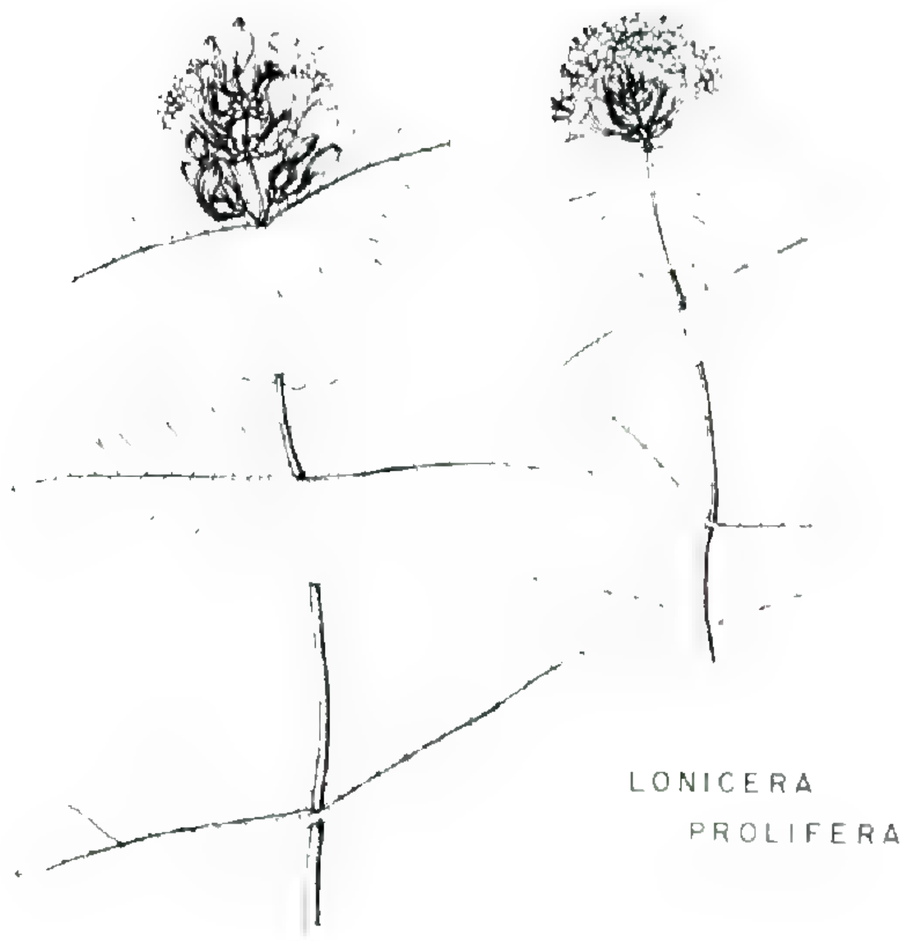
GELSEMIUM SEMPERVIRENS

GELSEMIUM
RANKINII

HEDERA HELIX

PIERIS PHILLYREIFOLIA

ANISOSTICHUS CAPREOLATA



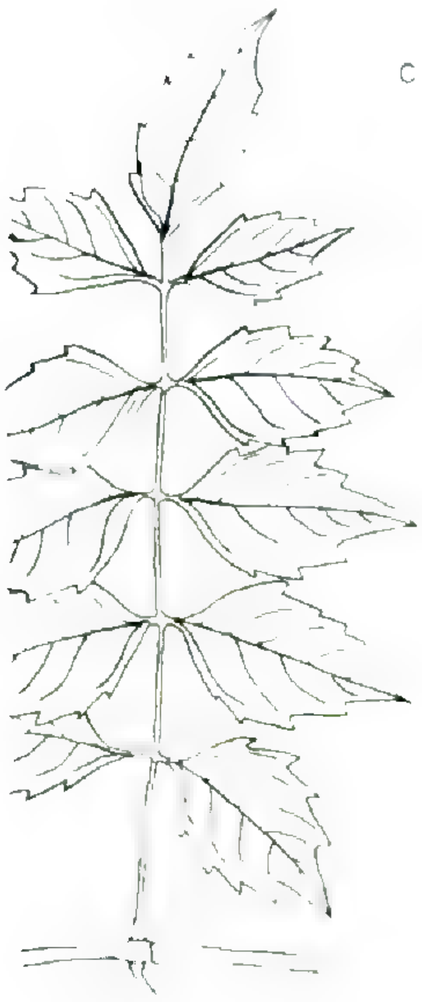
LONICERA
PROLIFERA

PERIPLOCA
GRAECA

LONICERA
FLAVA

CYNANCHUM SCOPARIUM

CAMPSIS RADICANS

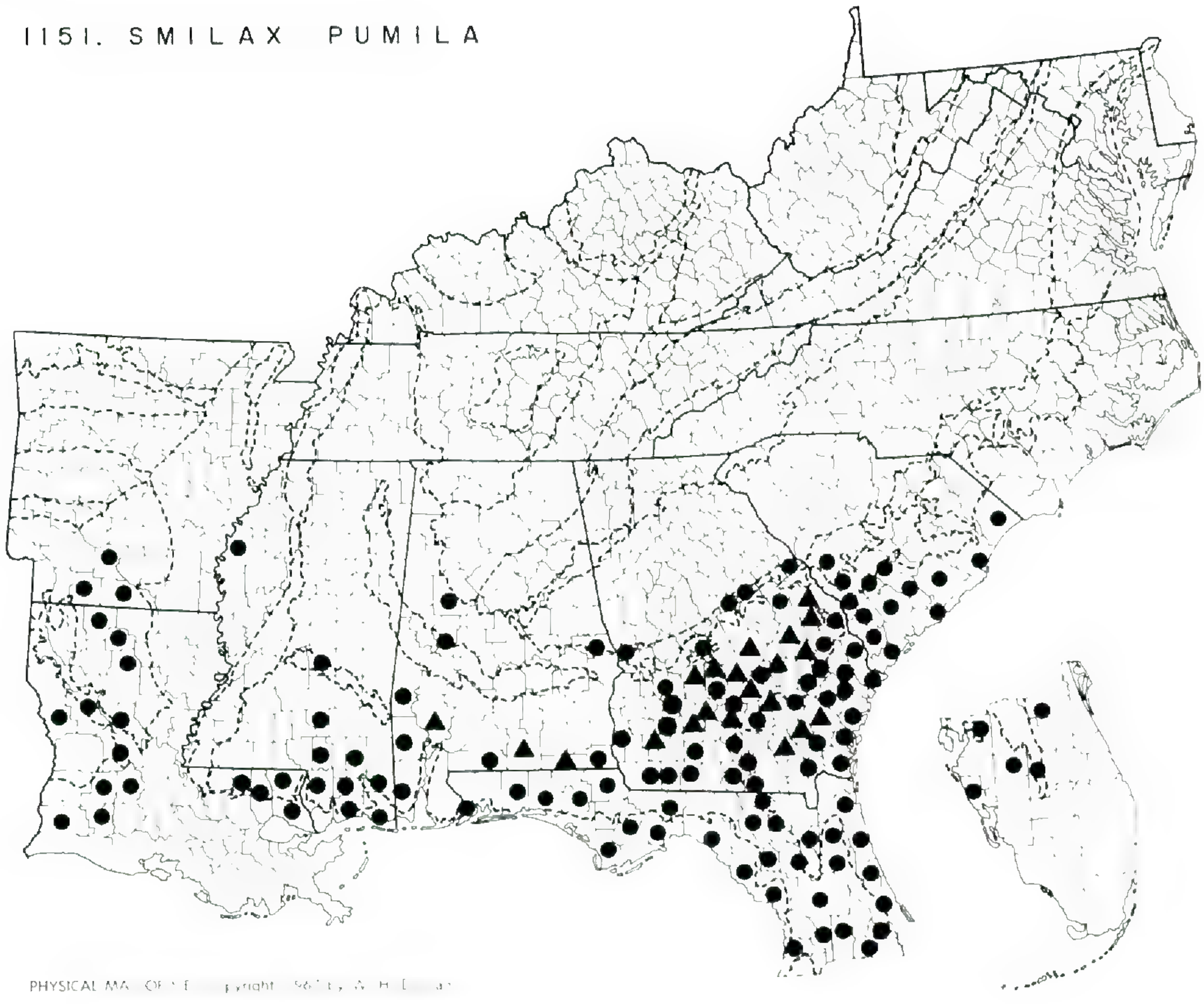


LONICERA
DIOICA

LONICERA JAPONICA

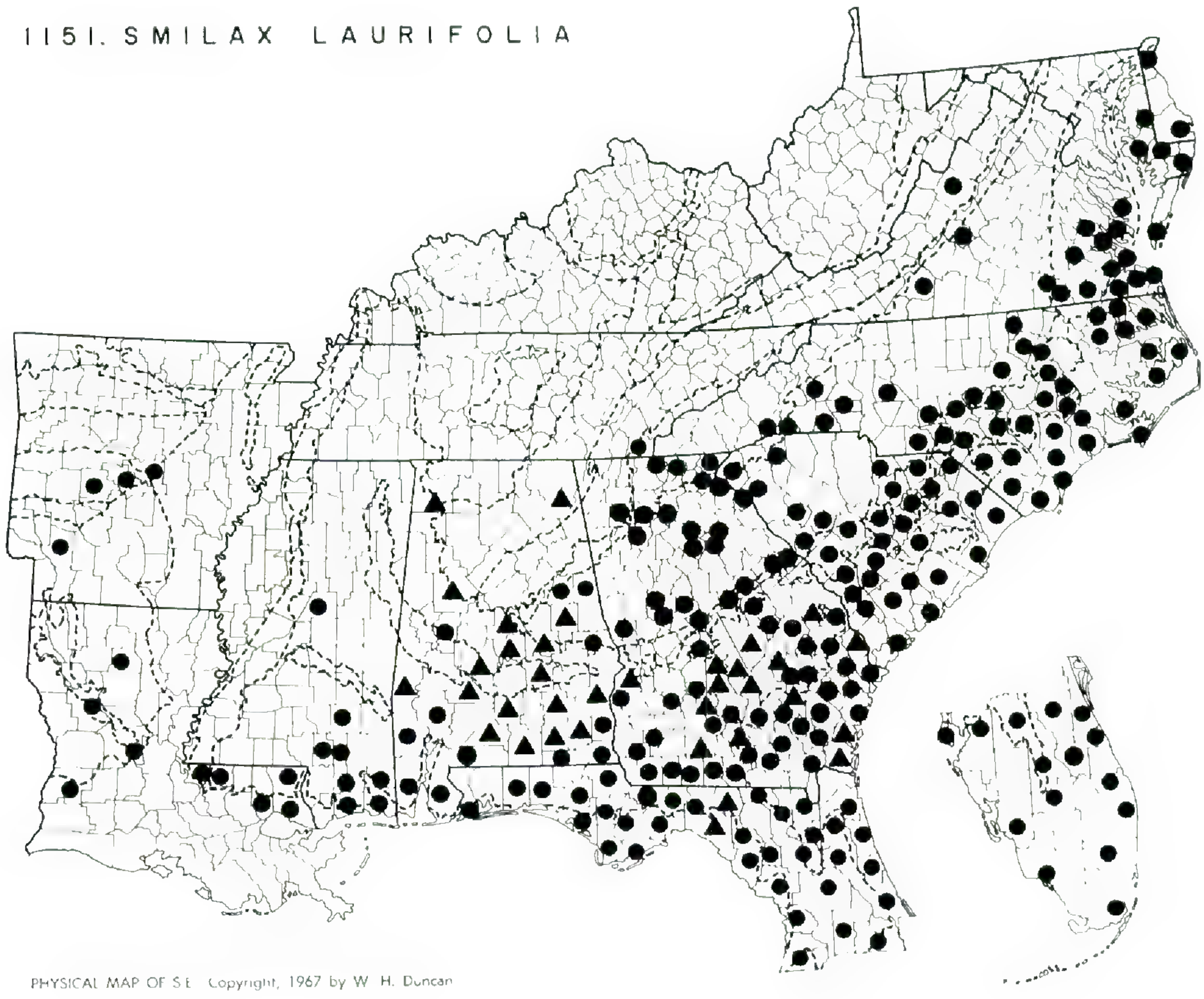
LONICERA SEMPERVIRENS

1151. SMILAX PUMILA



PHYSICAL MAP OF S E Copyright, 1967 by W H. Duncan

1151. SMILAX LAURIFOLIA



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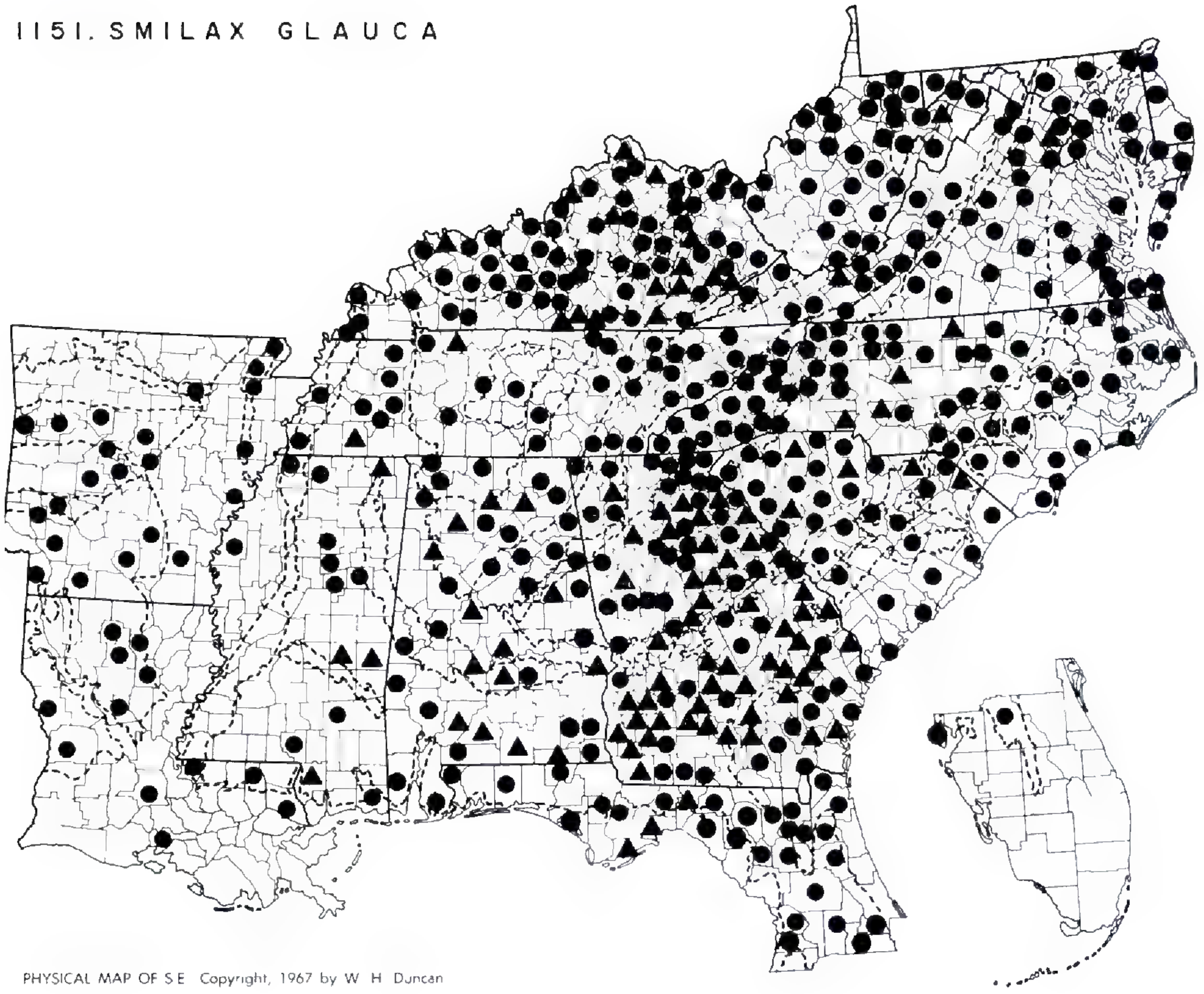
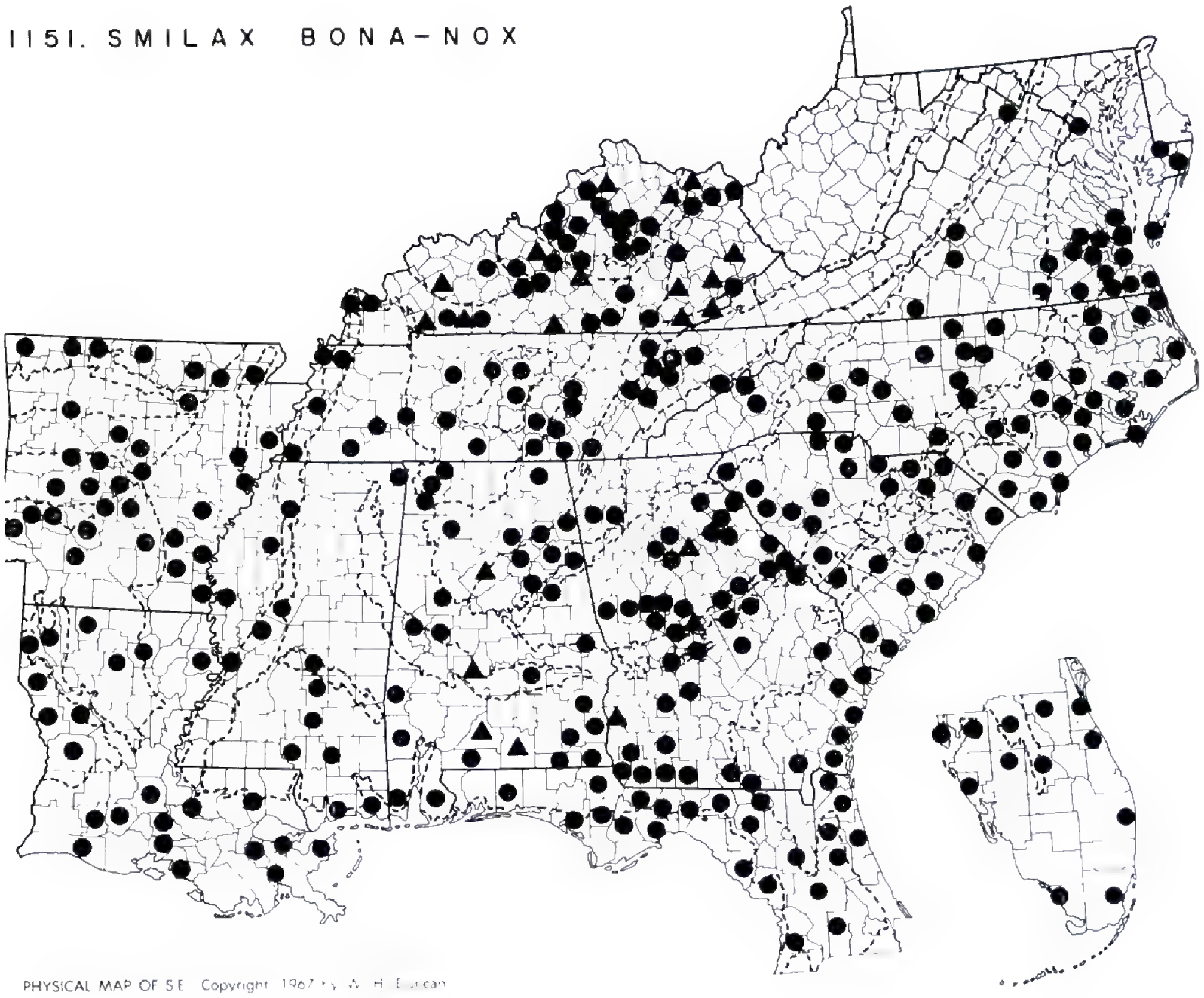
1151. SMILAX GLAUCA



PHYSICAL MAP OF S E Copyright, 1967 by W H Duncan

1151. SMILAX BONA-NOX



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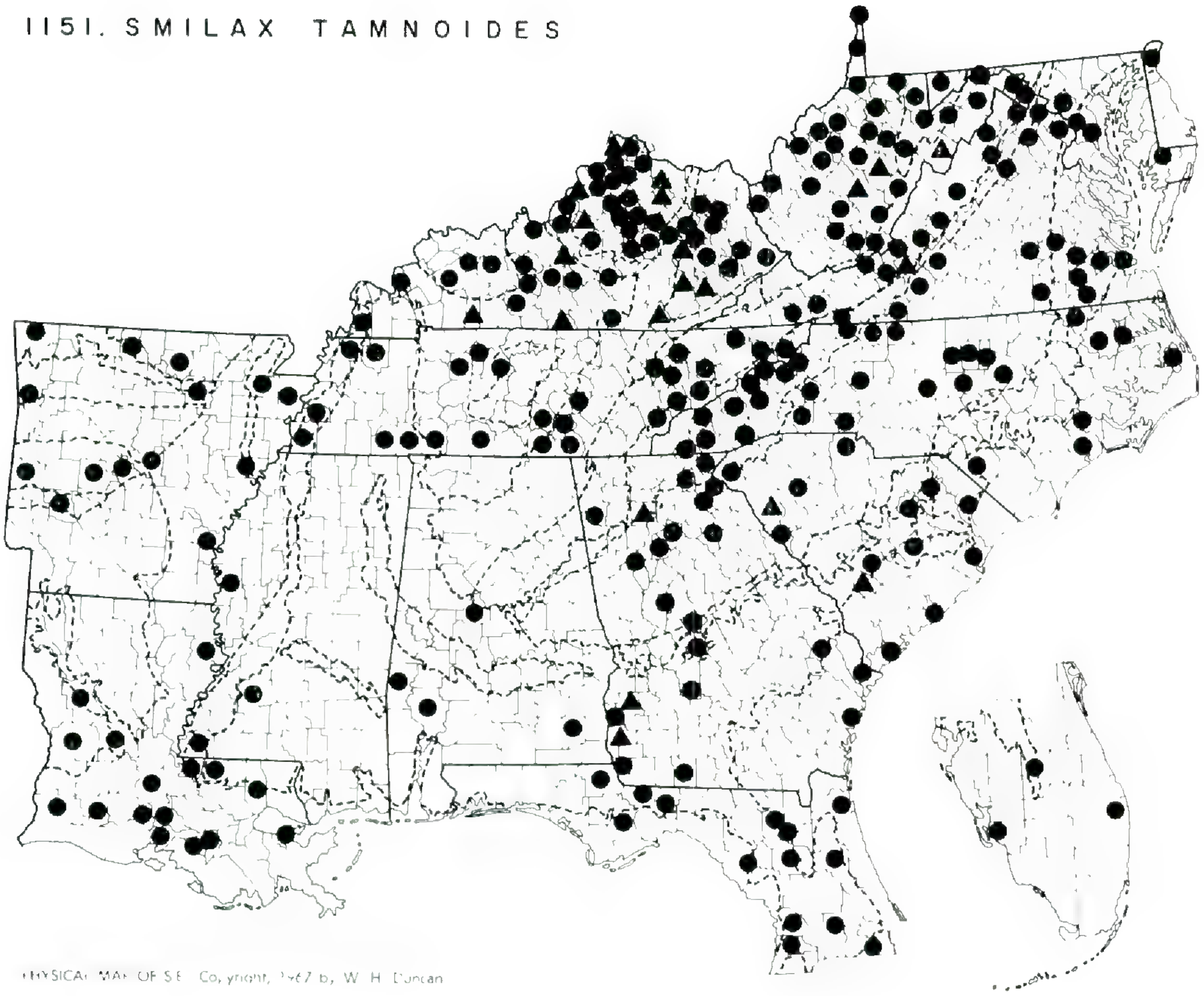
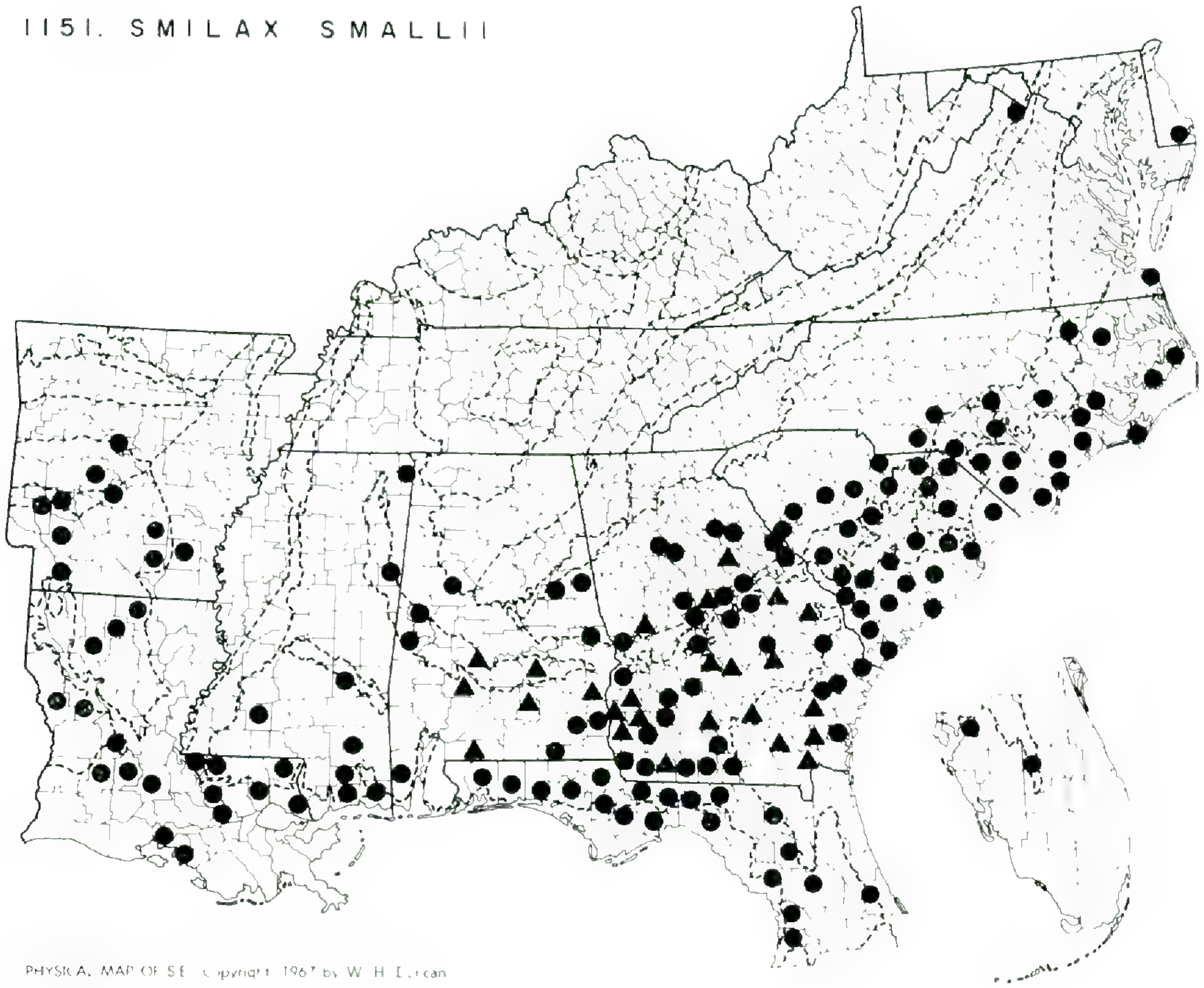
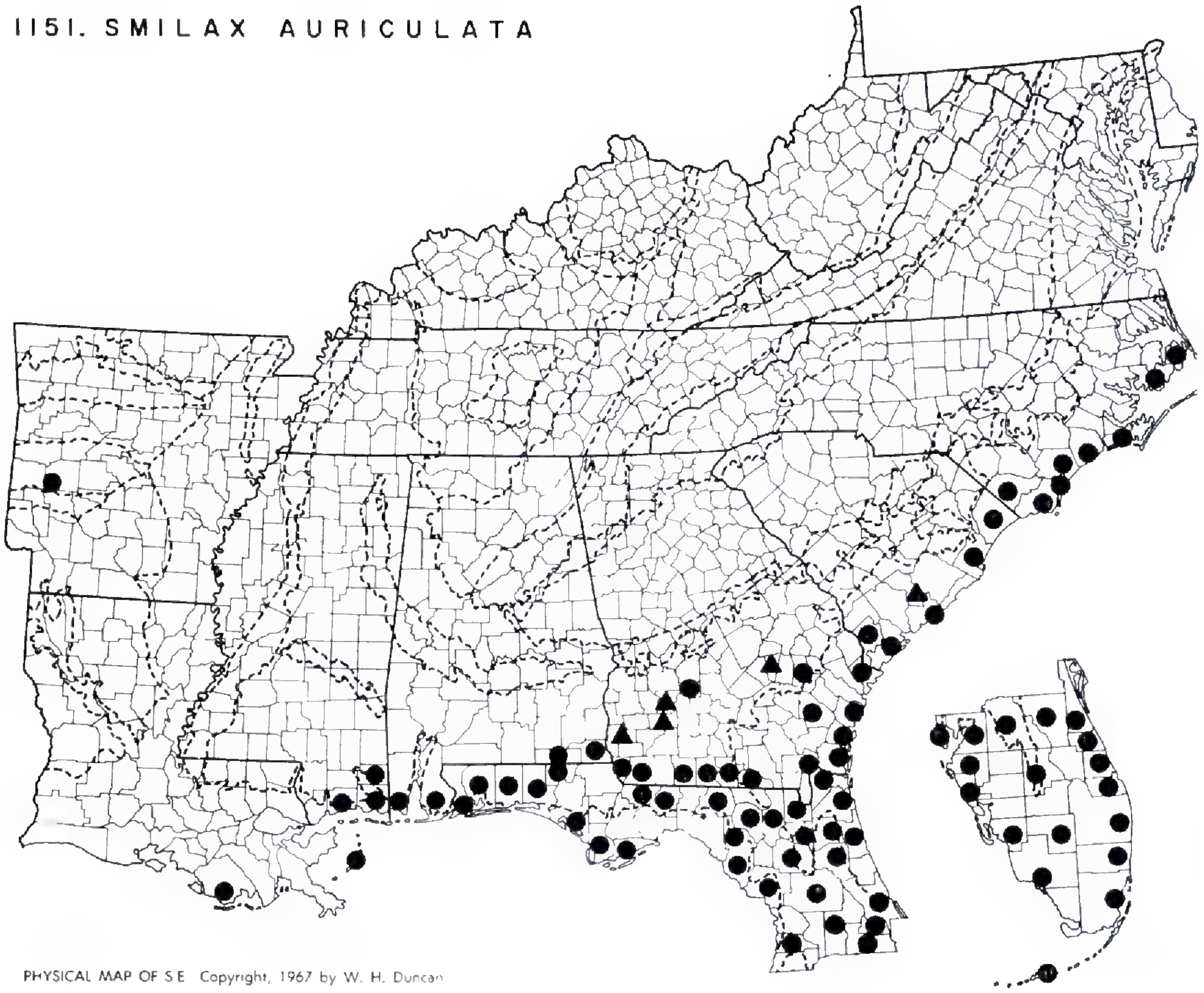
1151. SMILAX TAMNOIDES



1151. SMILAX SMALLII



1151. SMILAX AURICULATA



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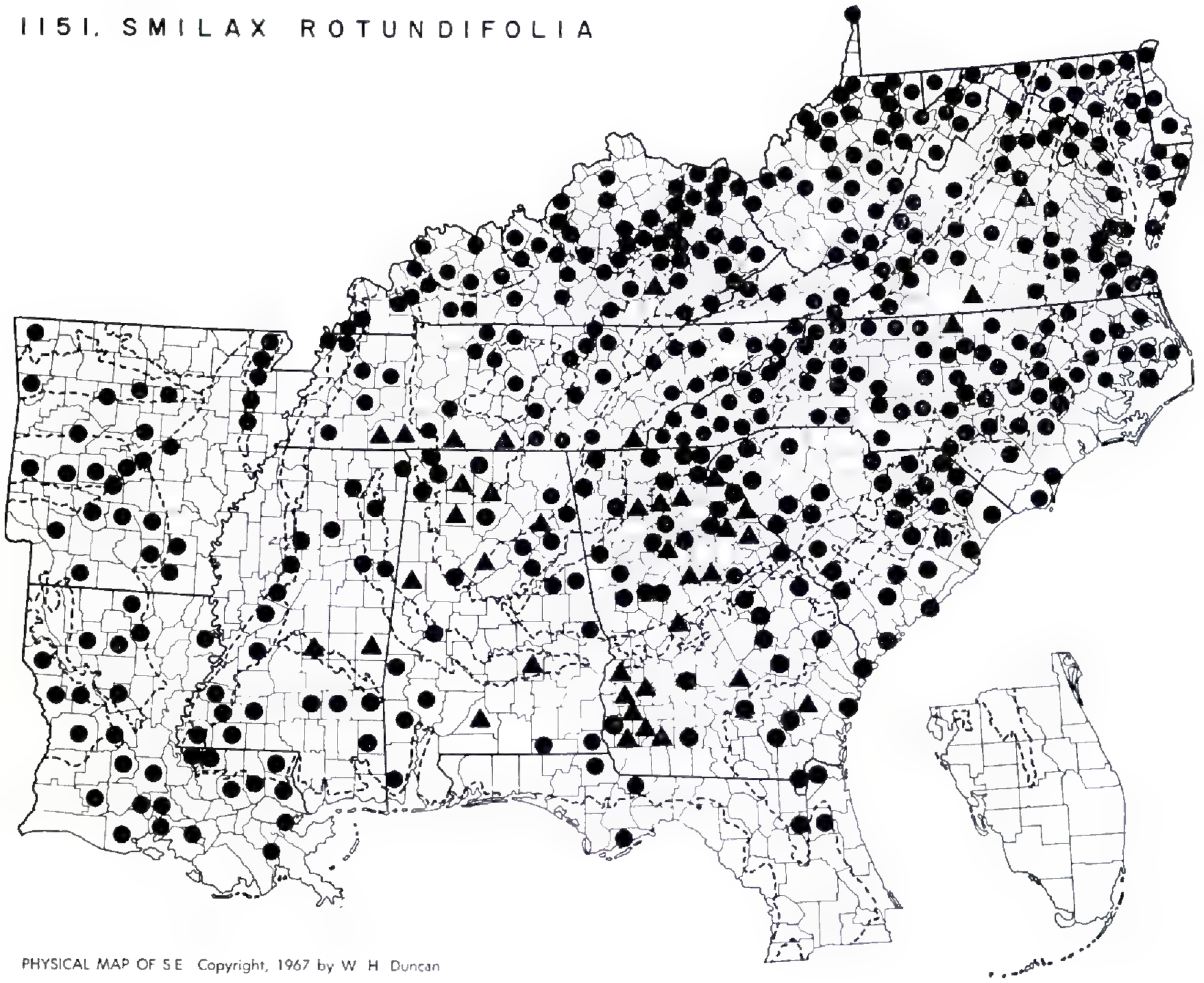
1151. SMILAX ROTUNDIFOLIA



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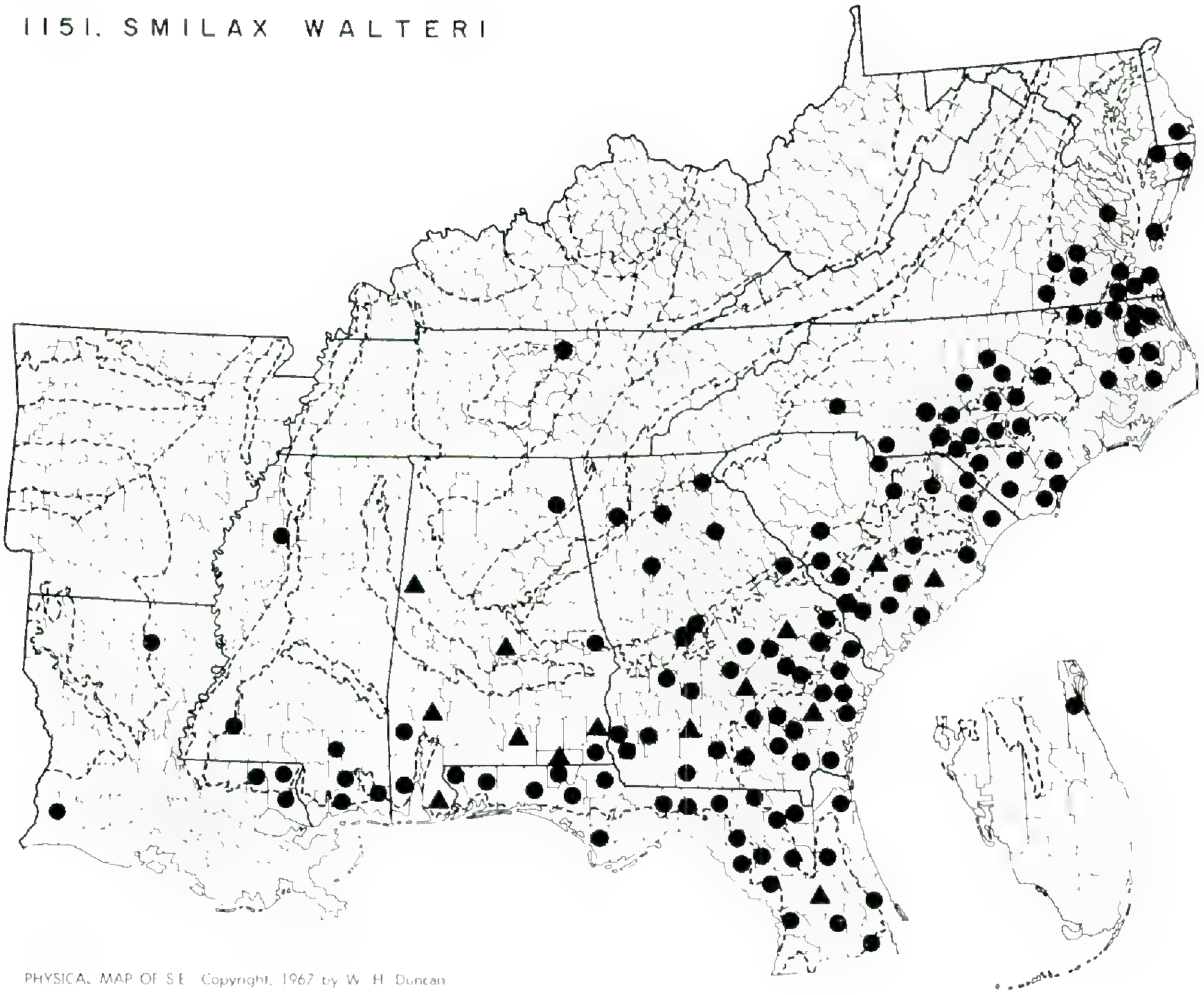
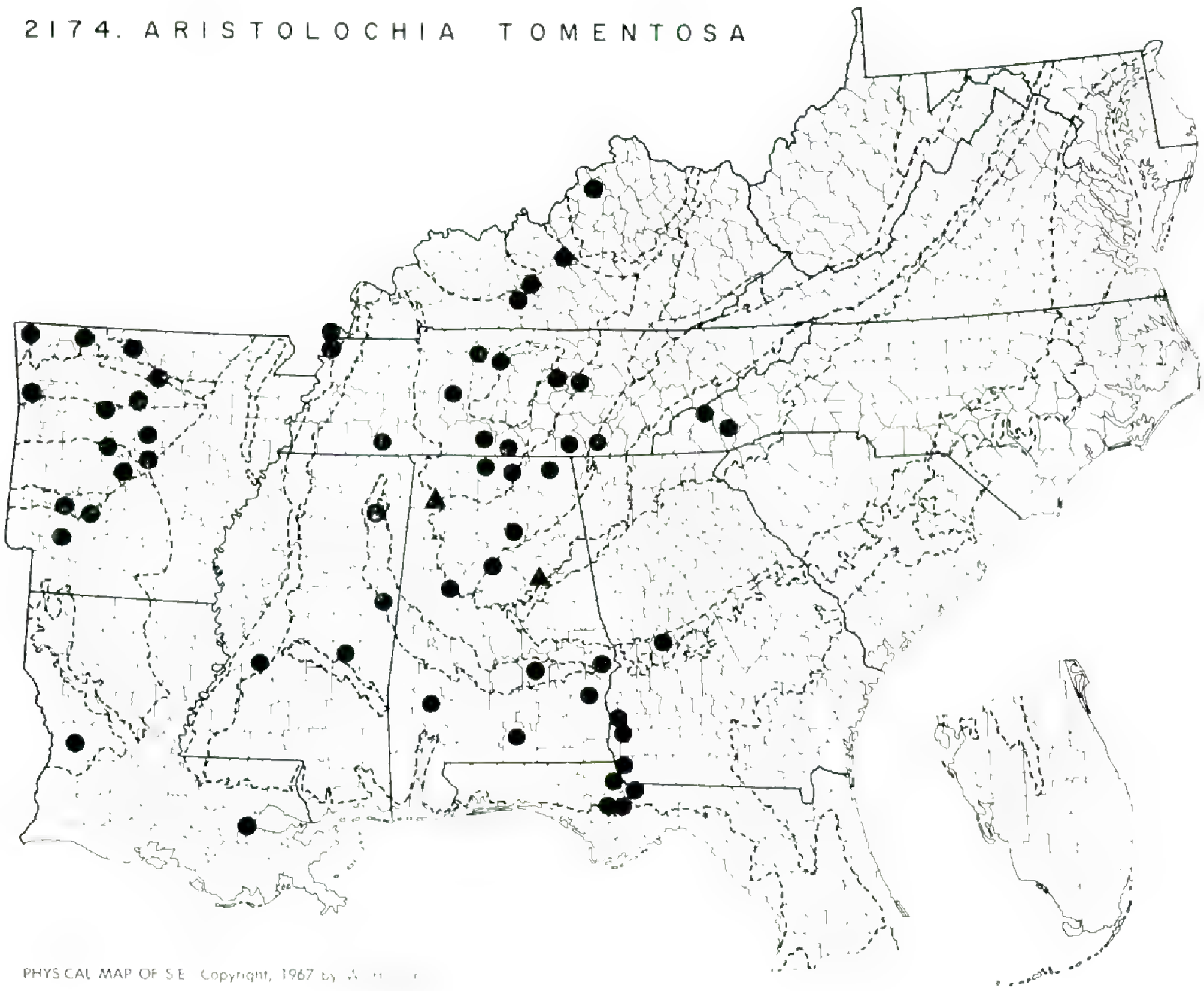
1151. SMILAX WALTERI



PHYSICAL MAP OF S.E. Copyright, 1967 by W. H. Duncan

2174. ARISTOLOCHIA TOMENTOSA



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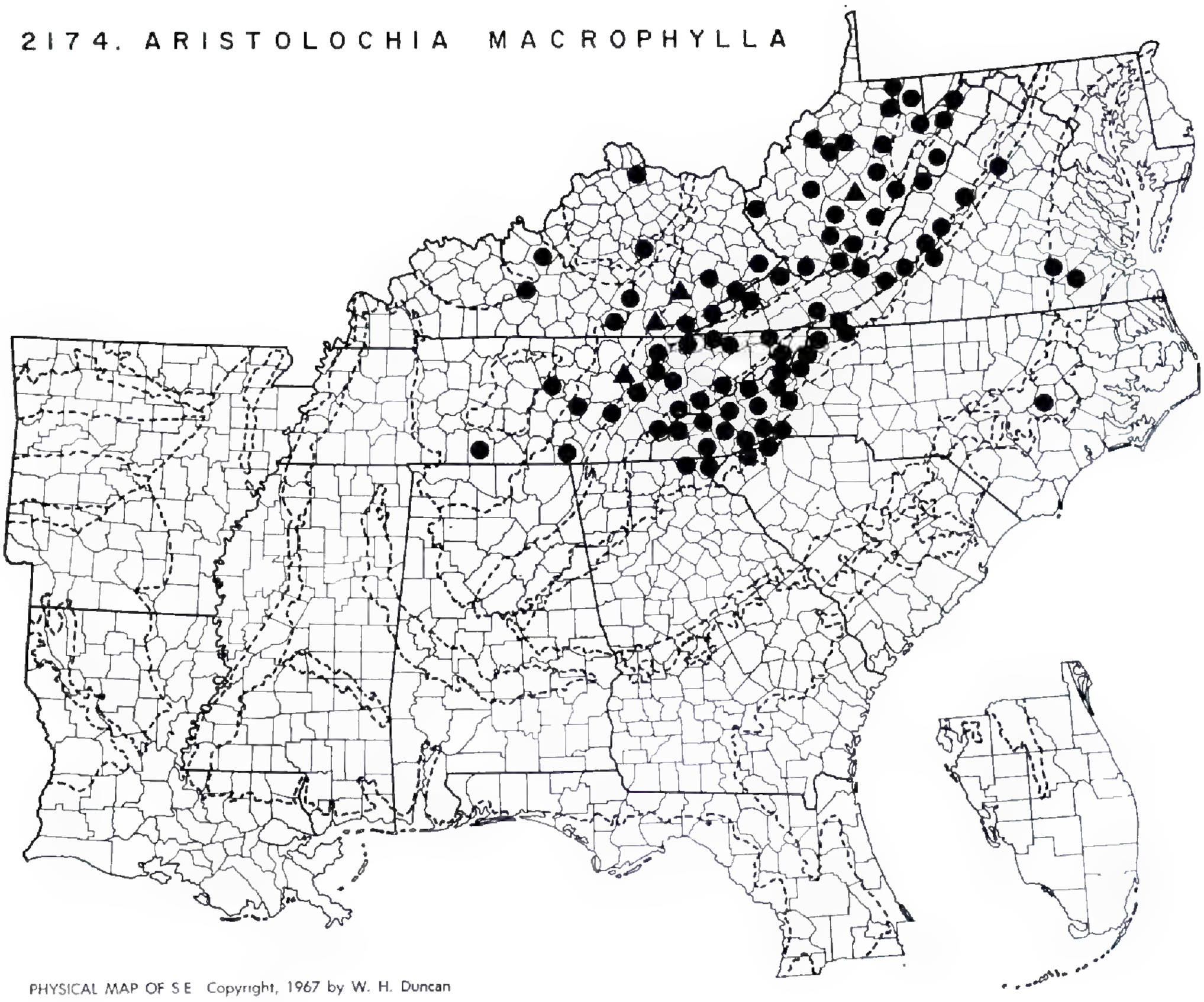
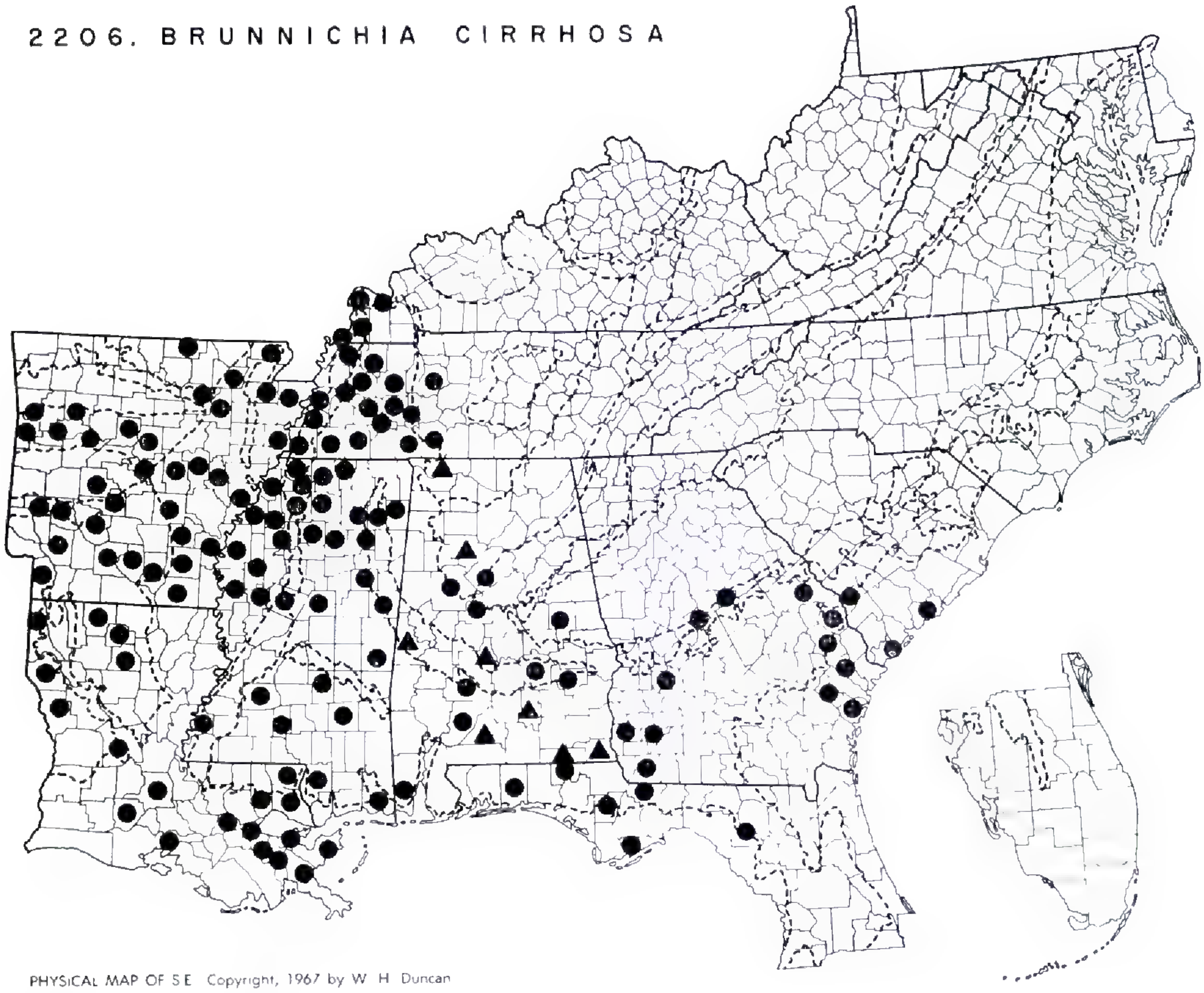
2174. ARISTOLOCHIA MACROPHYLLA



PHYSICAL MAP OF S E Copyright, 1967 by W. H. Duncan

2206. BRUNNICHIA CIRRHOSA



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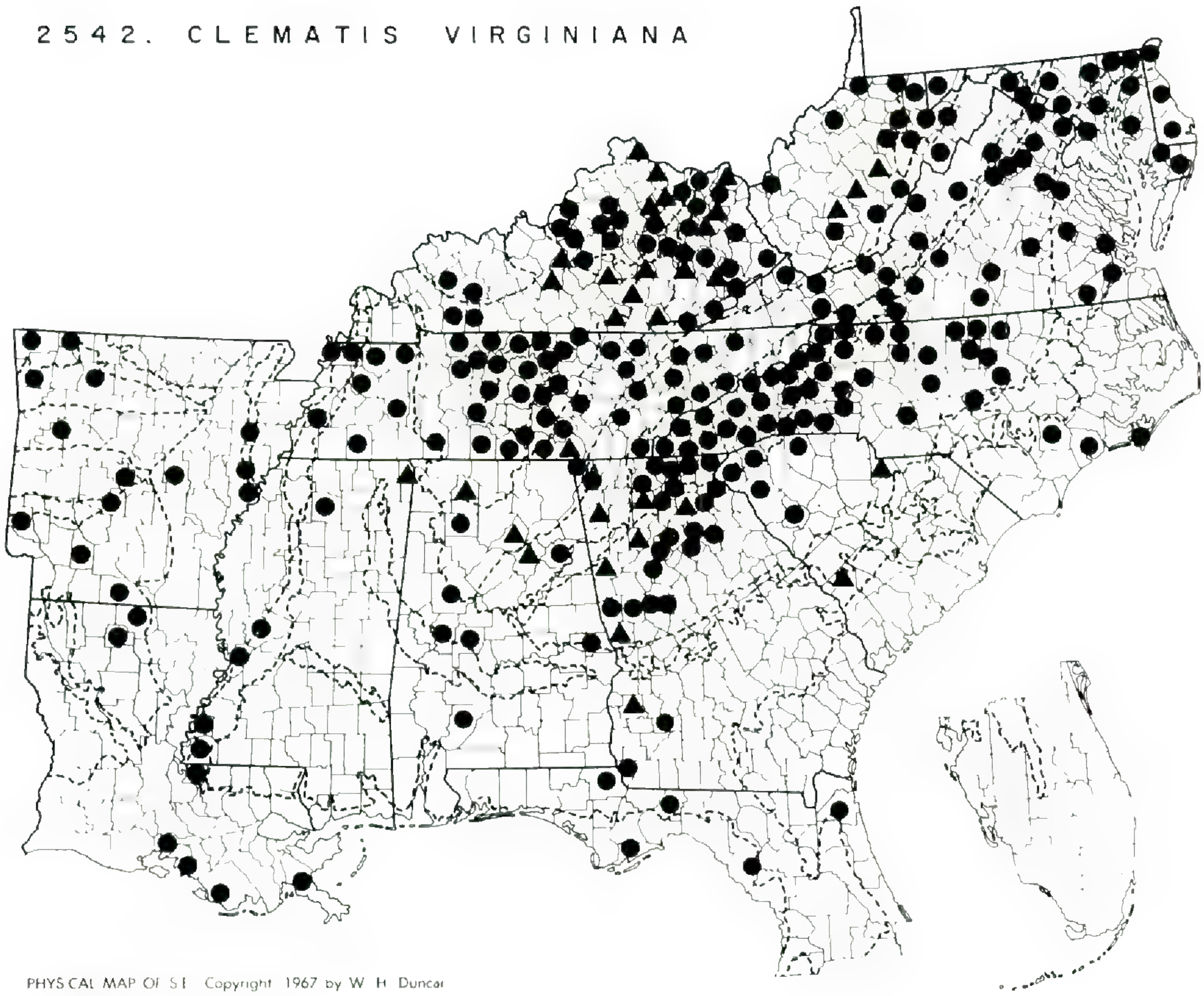
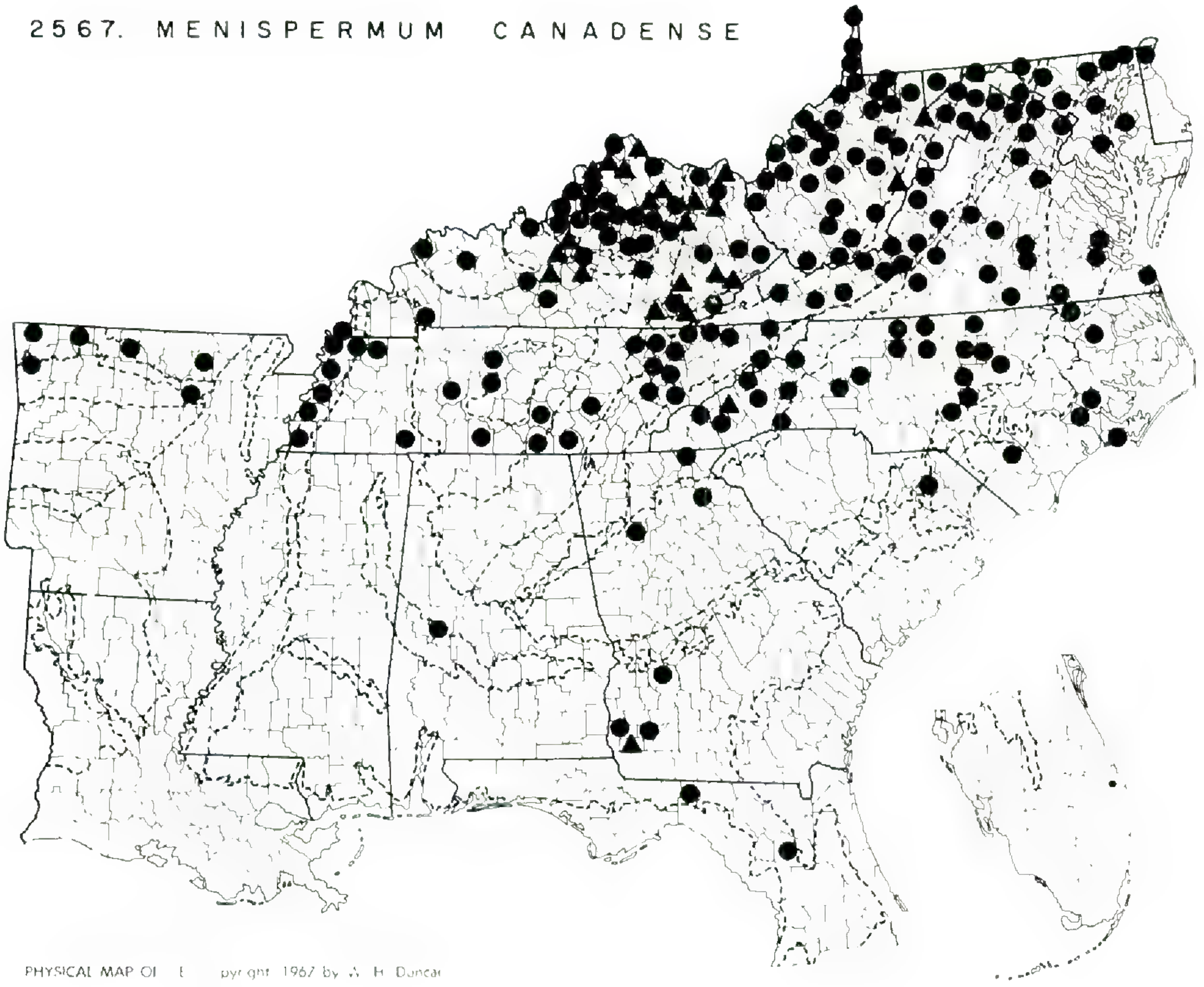
2542. CLEMATIS VIRGINIANA



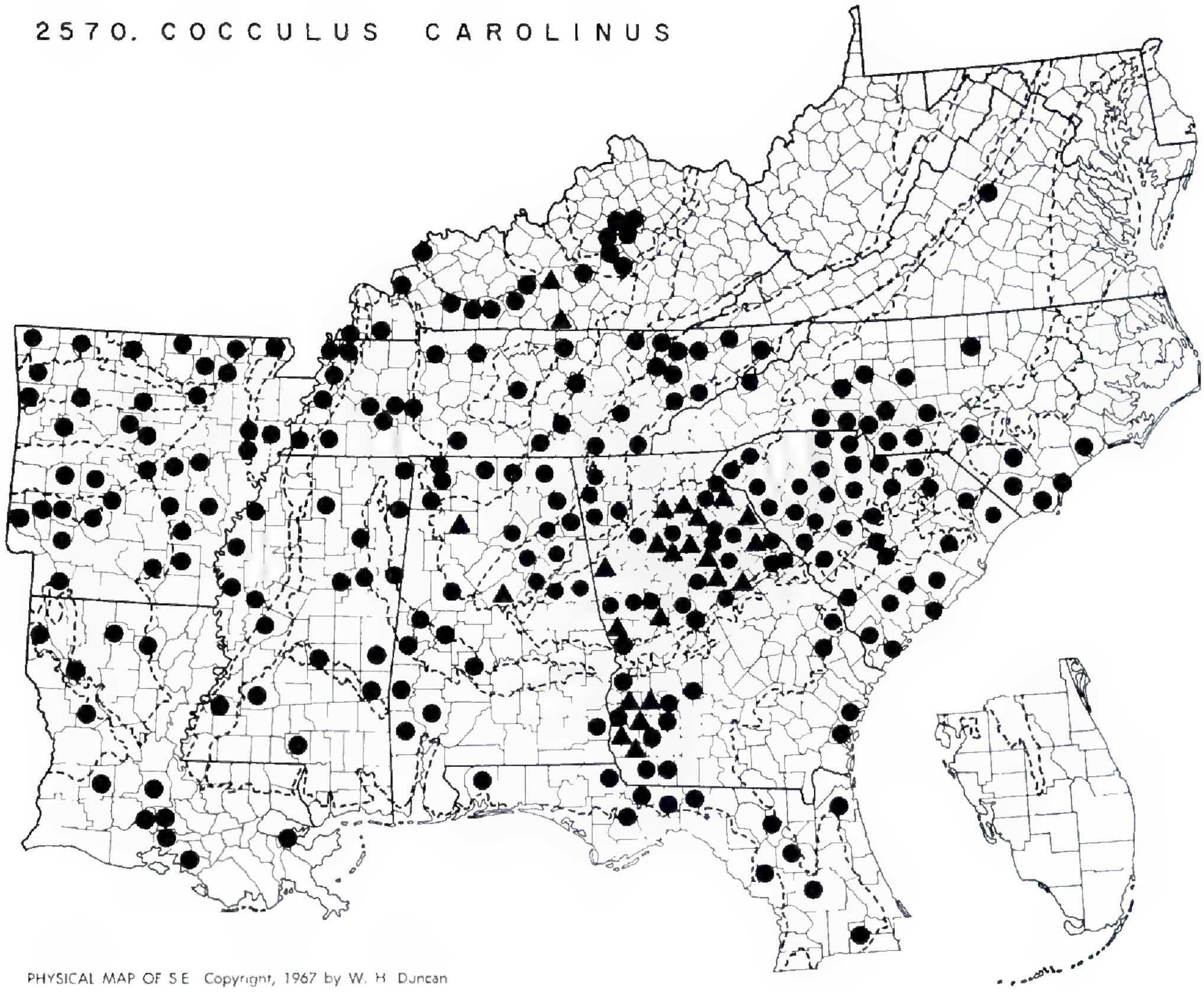
PHYSICAL MAP OF S E Copyright 1967 by W H Duncan

2567. MENISPERMUM CANADENSE



PHYSICAL MAP OF E pyright 1967 by W H Duncan

2570. COCCULUS CAROLINUS



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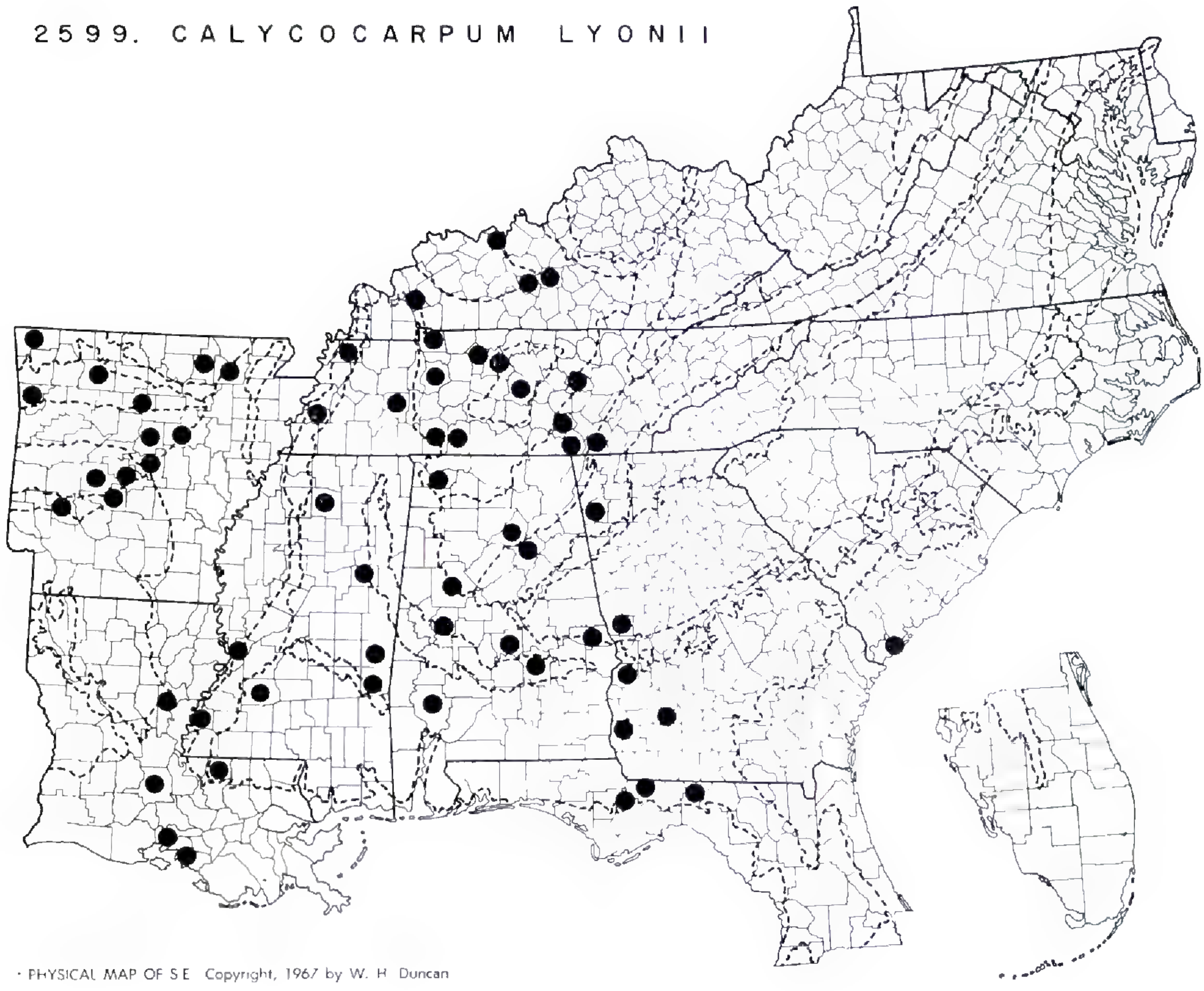
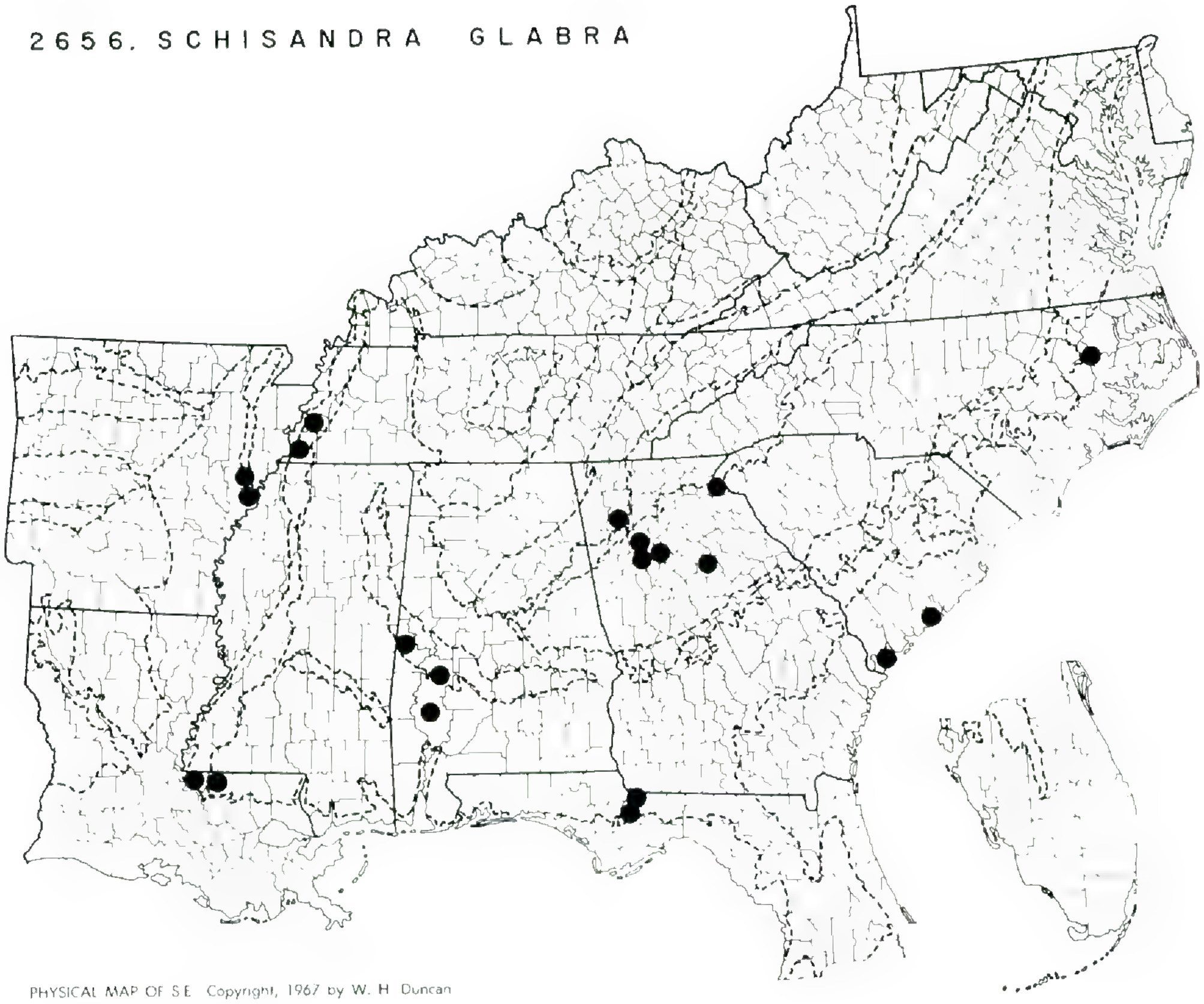
2599. CALYCOCARPUM LYONII



· PHYSICAL MAP OF S E Copyright, 1967 by W. H Duncan

2656. SCHISANDRA GLABRA



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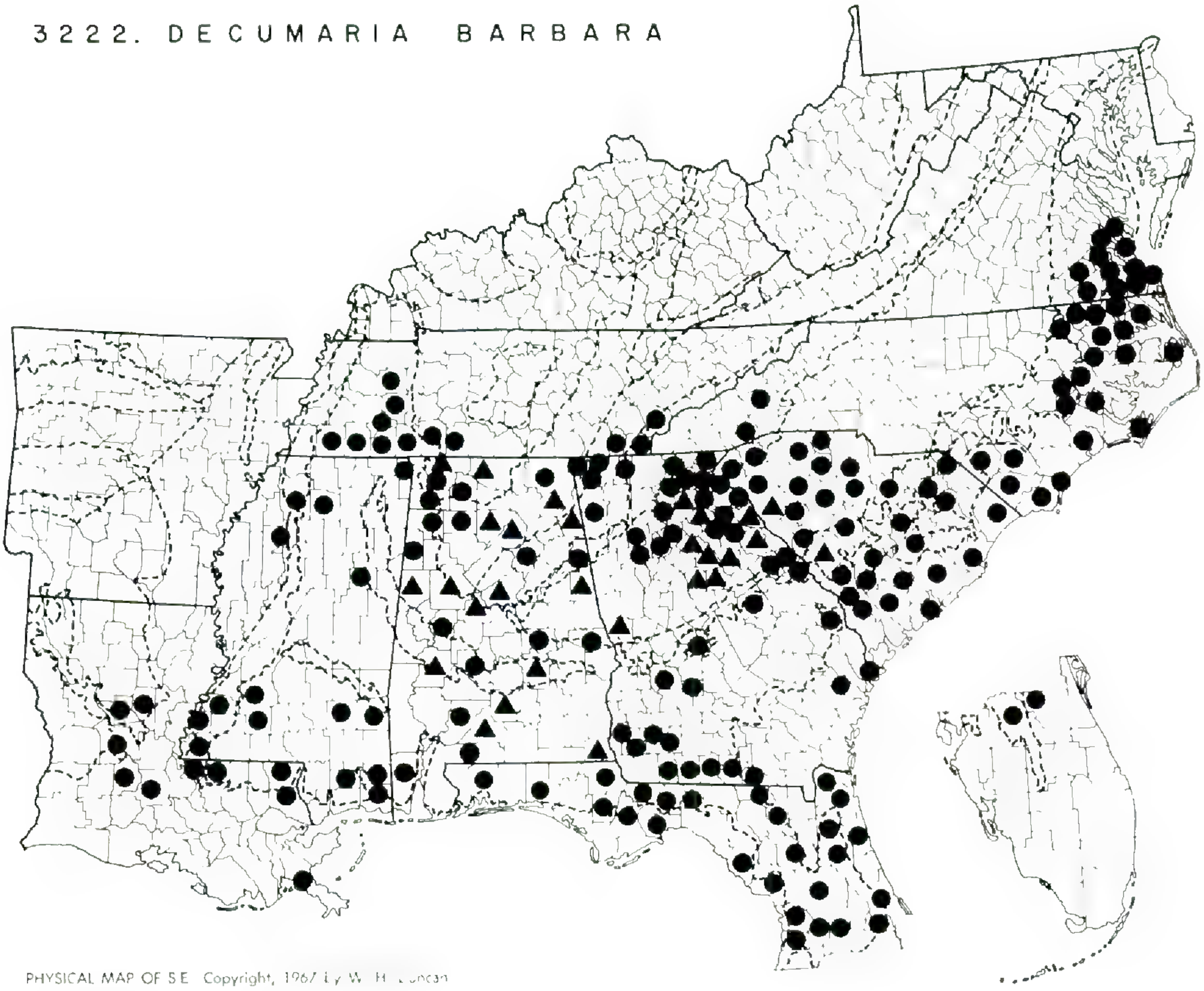
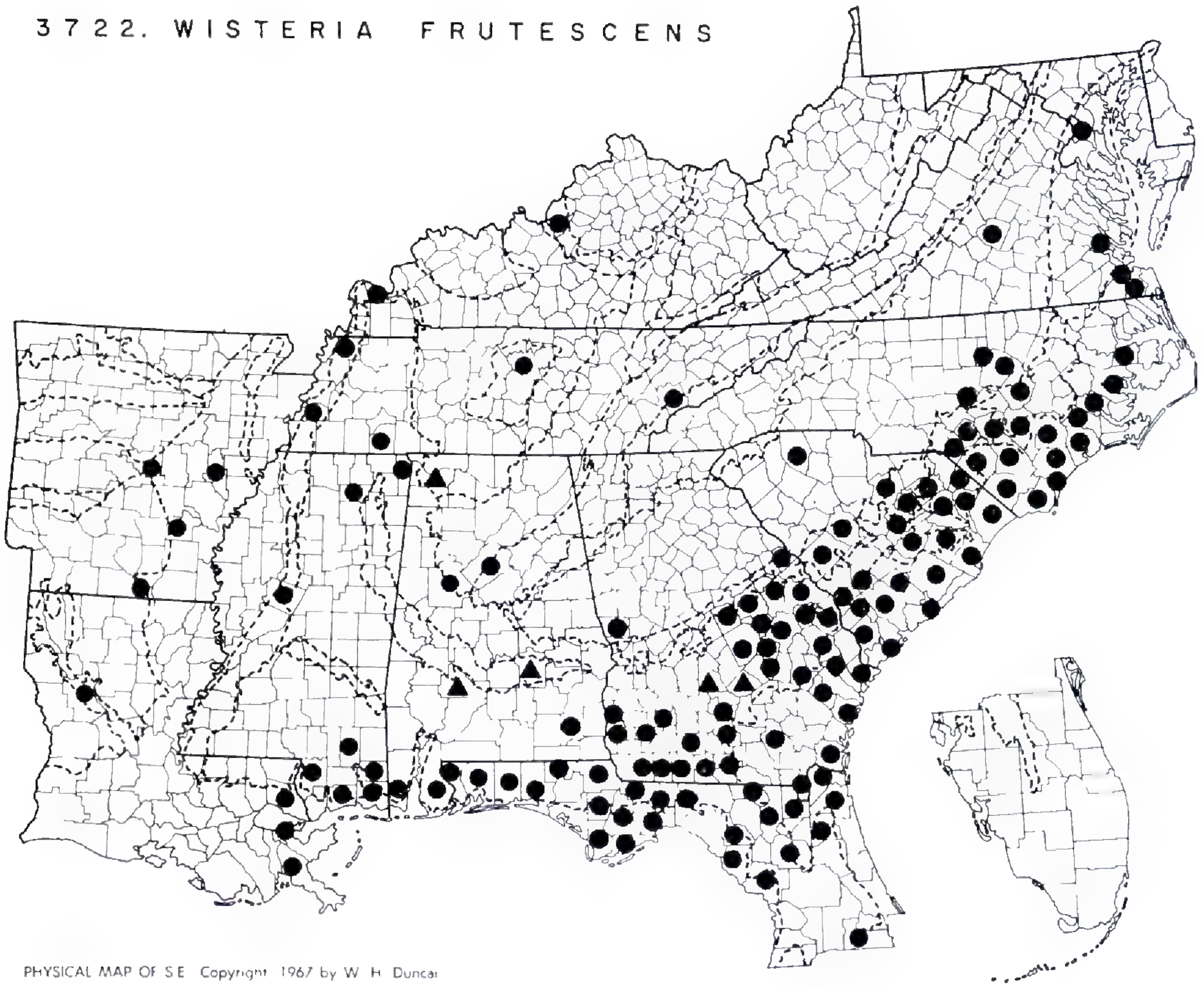
3222. DECUMARIA BARBARA



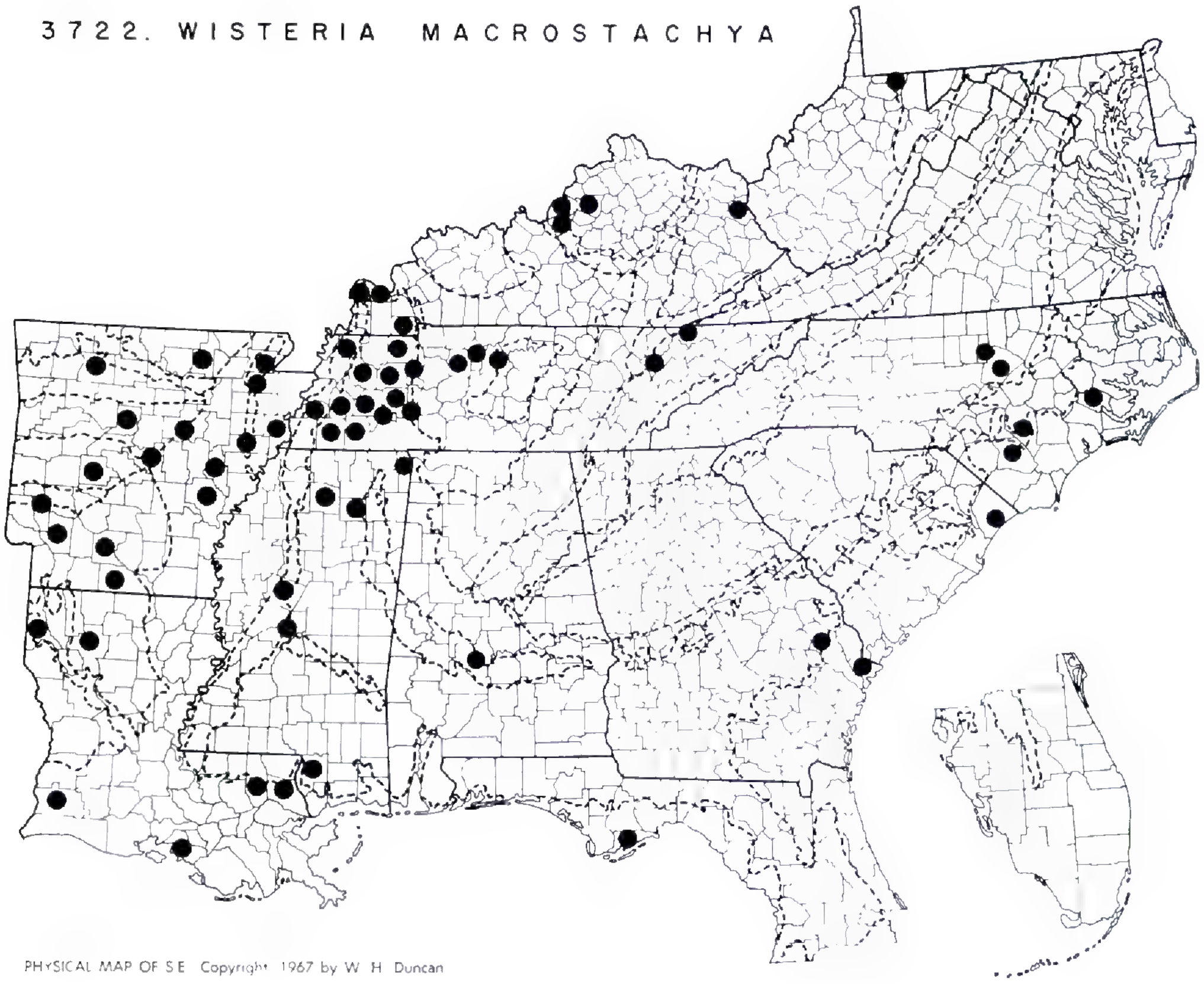
PHYSICAL MAP OF S.E. Copyright, 1967 by W. H. Duncan

3722. WISTERIA FRUTESCENS



PHYSICAL MAP OF S E Copyright 1967 by W H Duncan

3722. WISTERIA MACROSTACHYA



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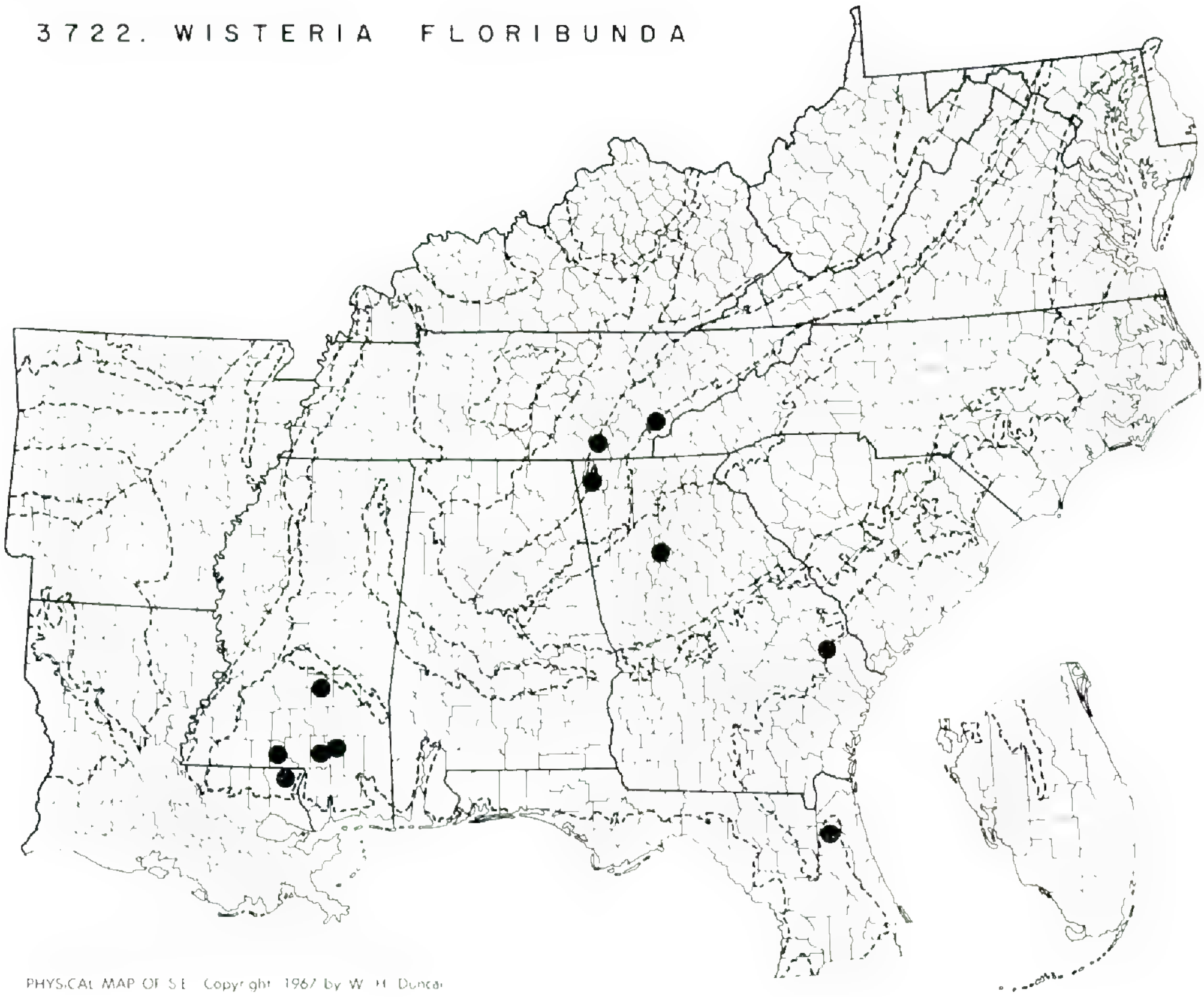
3722. WISTERIA FLORIBUNDA



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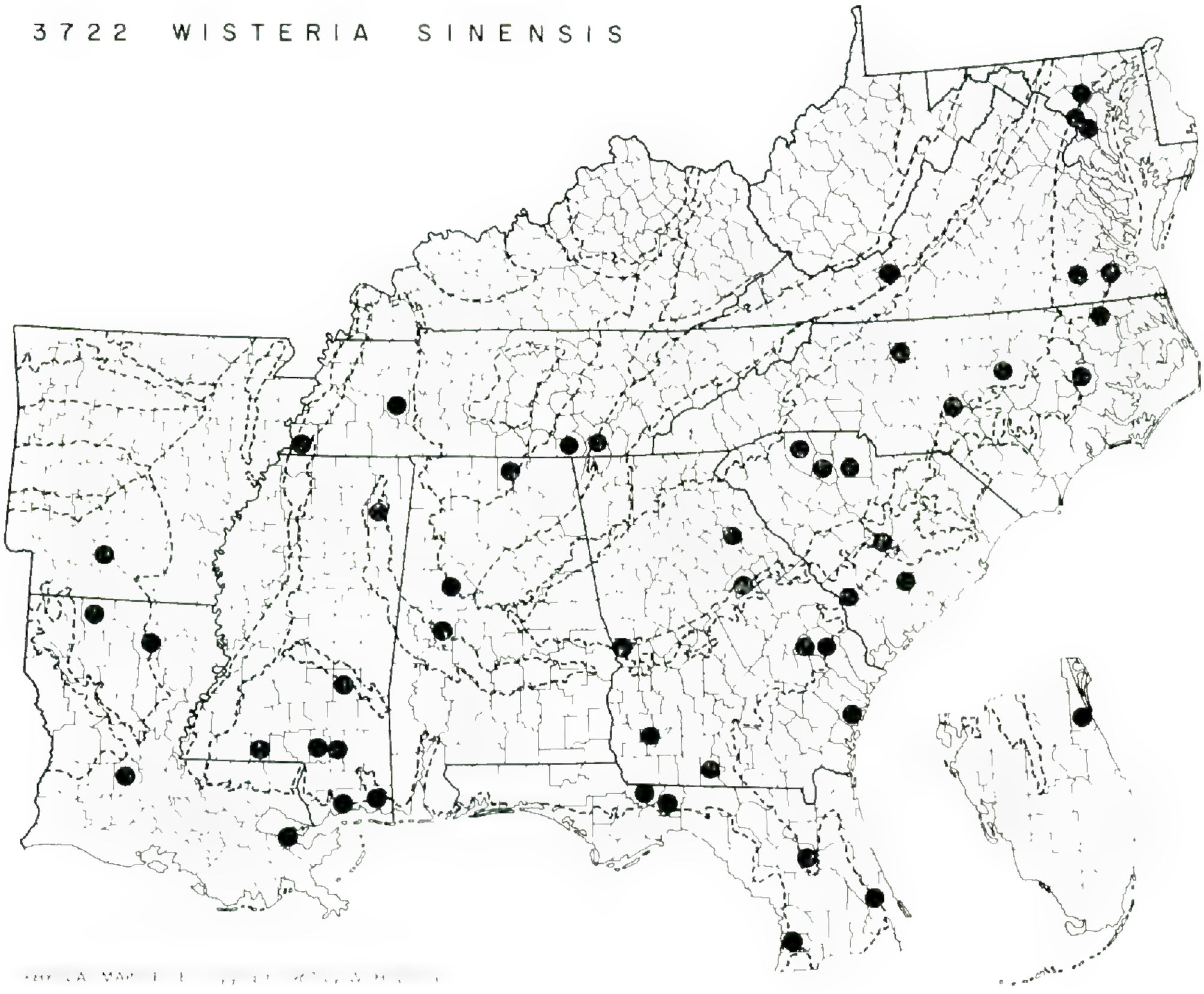
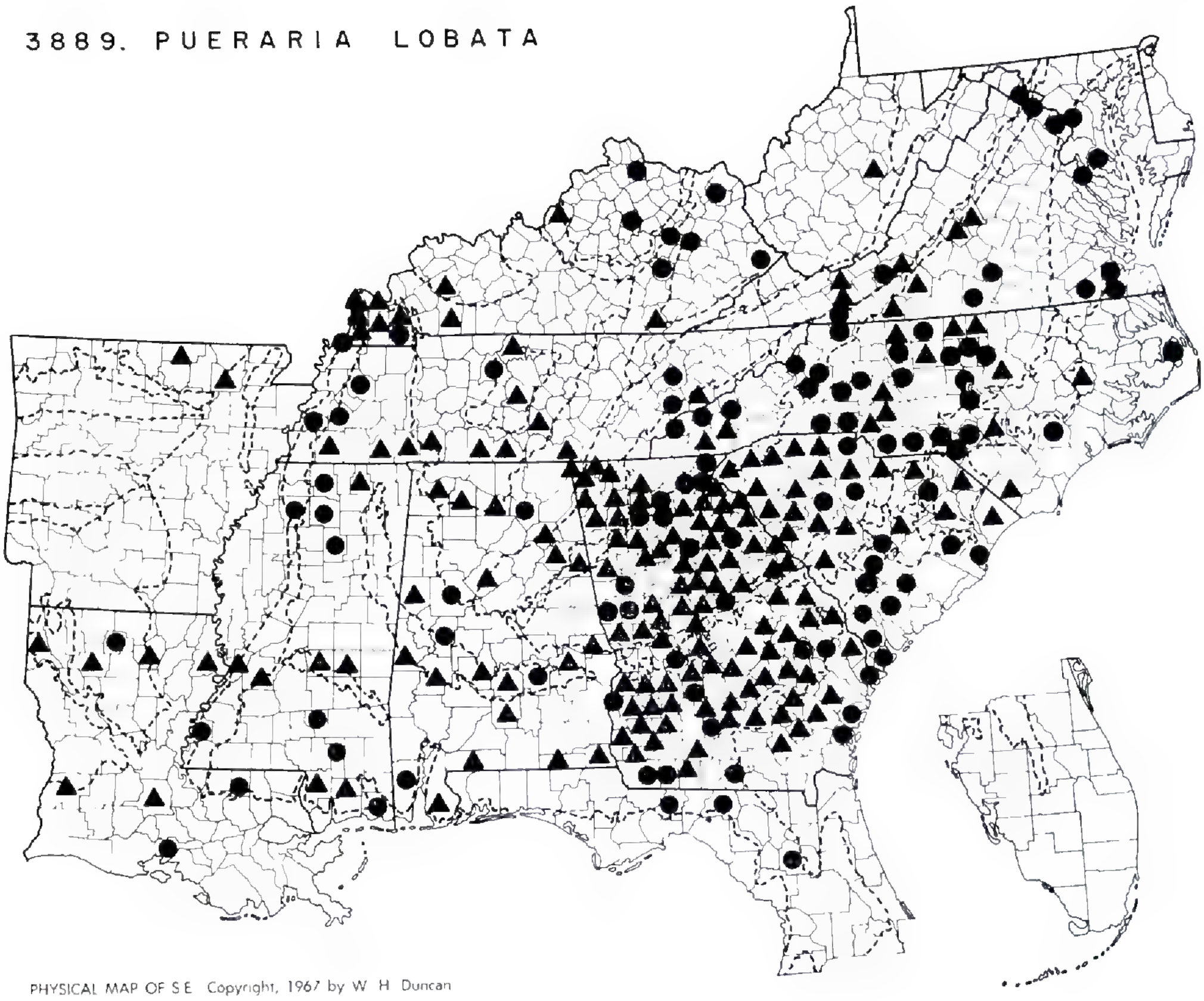
3722 WISTERIA SINENSIS



3889. PUERARIA LOBATA



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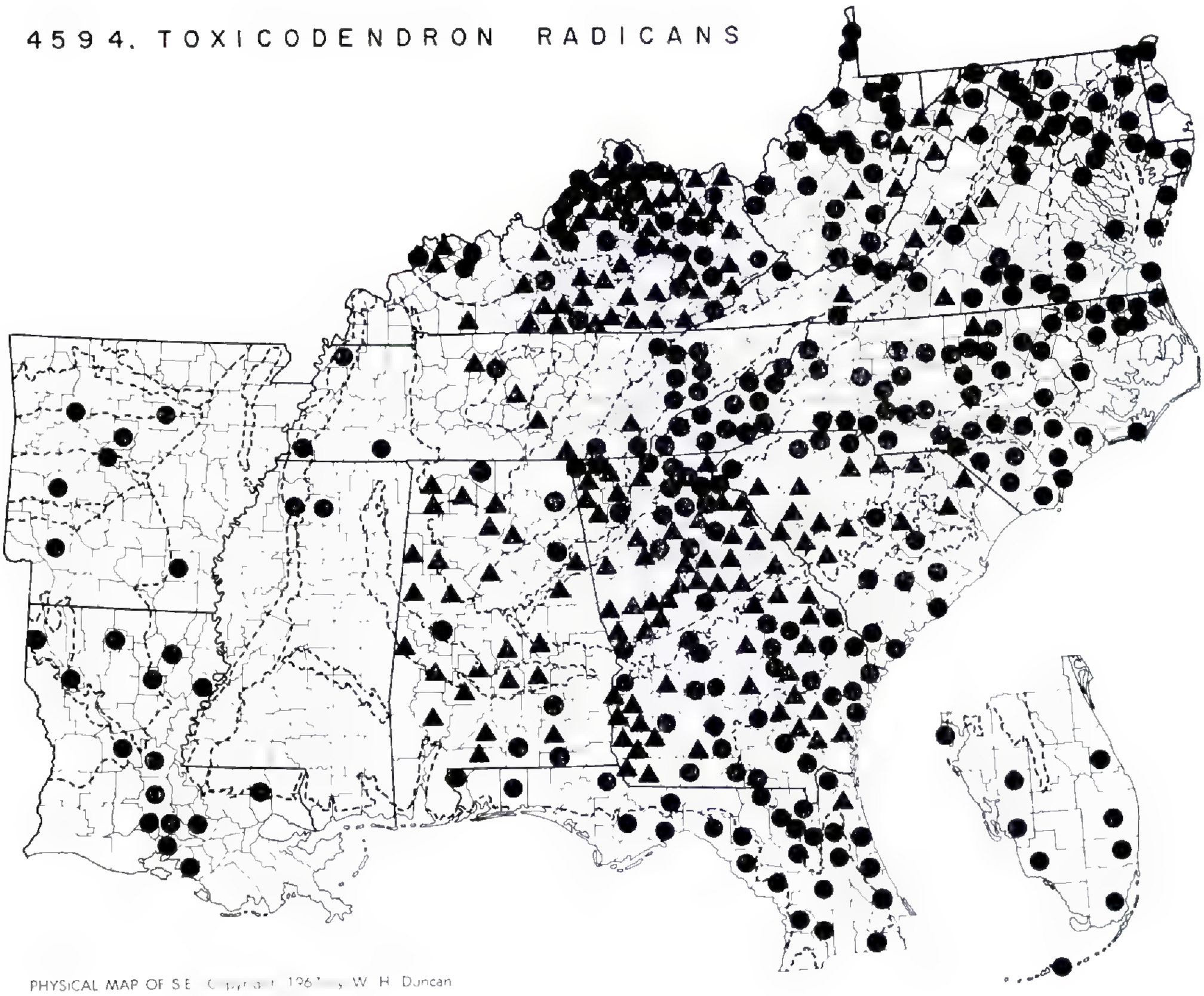
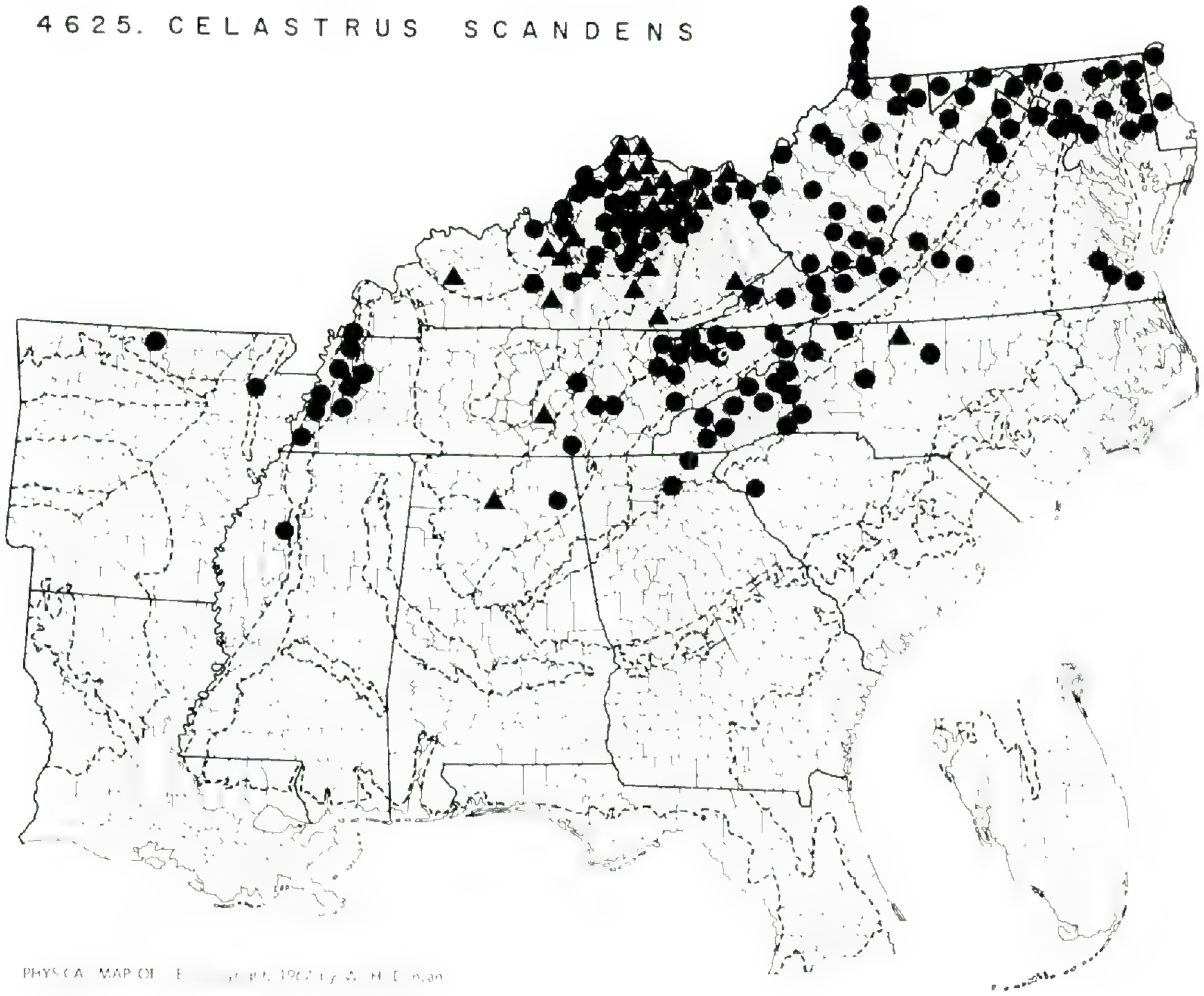
4594. TOXICODENDRON RADICANS



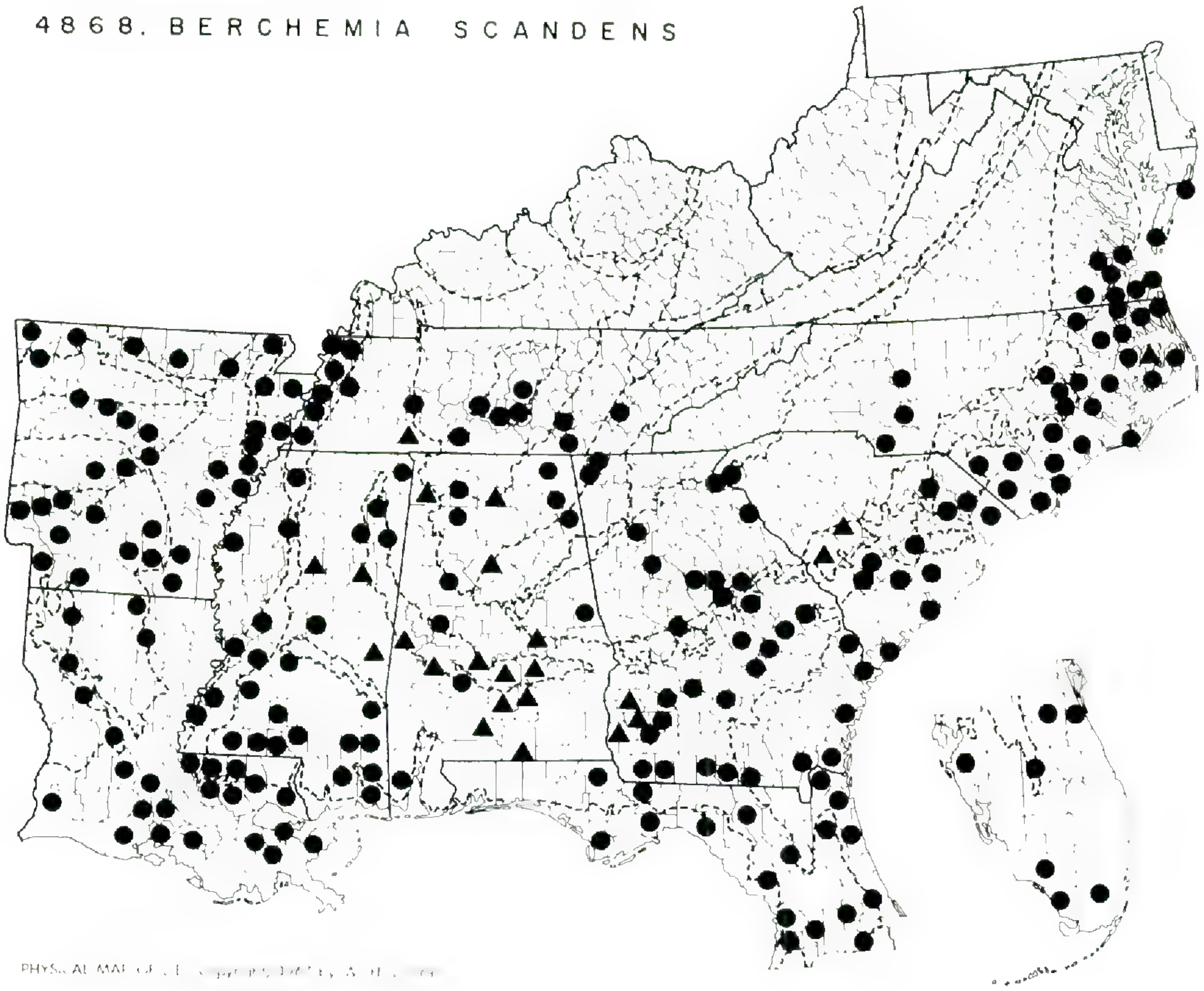
PHYSICAL MAP OF S E Copyright, 1967 by W H Duncan

4625. CELASTRUS SCANDENS



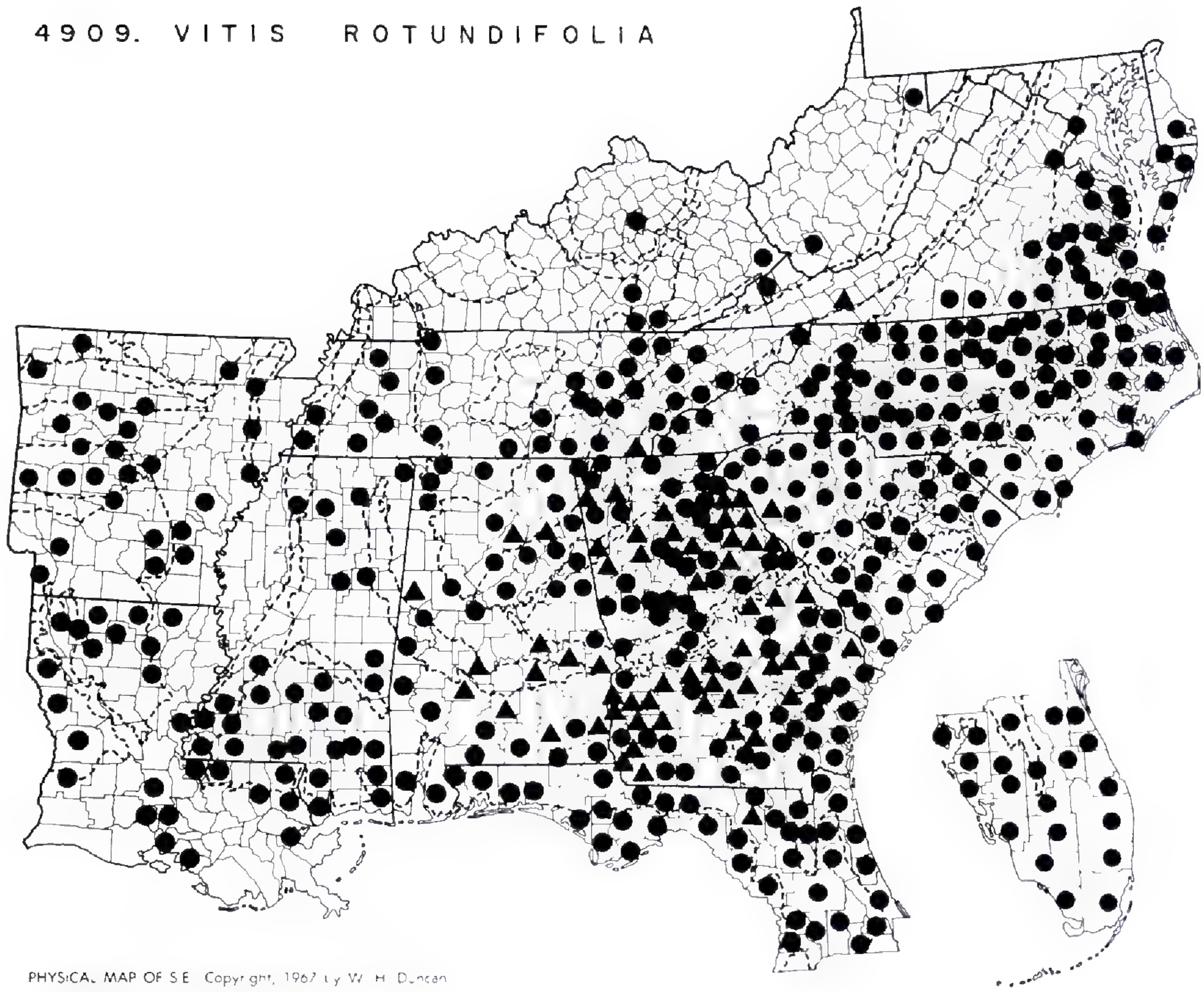
PHYSICAL MAP OF [illegible]

4868. BERCHEMIA SCANDENS



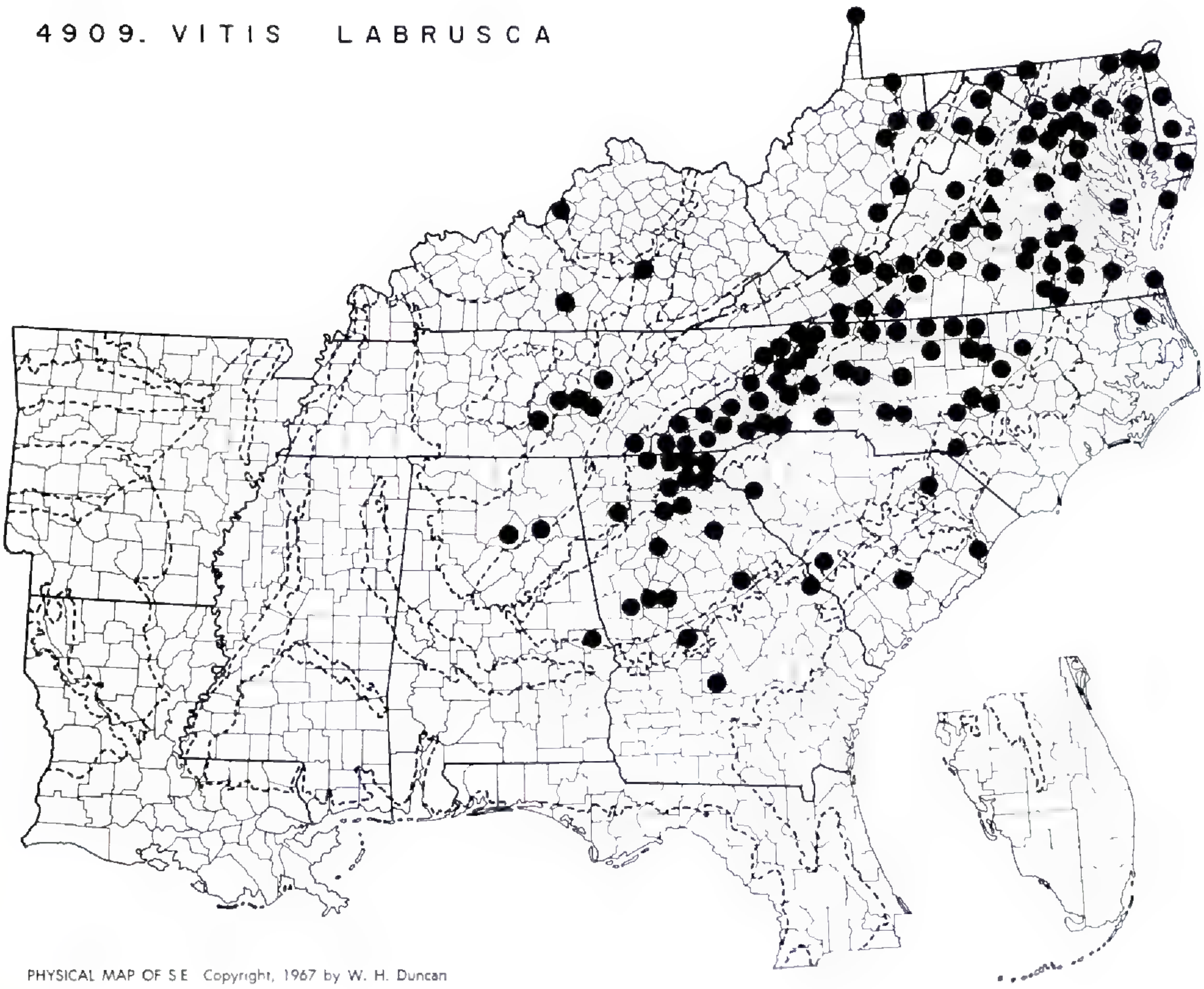
PHYSICAL MAP OF [illegible]

4909. VITIS ROTUNDIFOLIA



PHYSICAL MAP OF S E Copyright, 1967 by W. H. Duncan

4909. VITIS LABRUSCA



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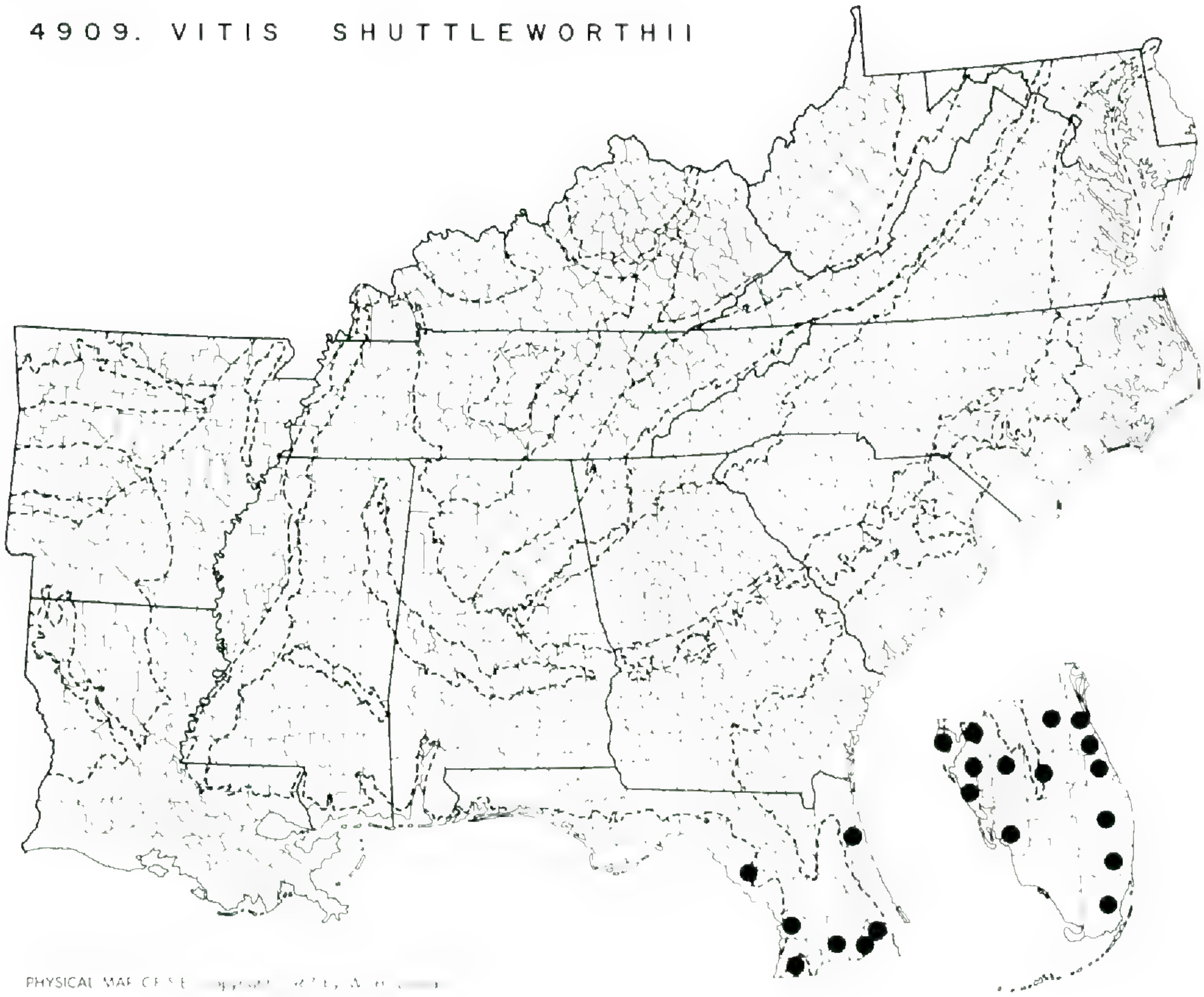
4909. VITIS SHUTTLEWORTHII



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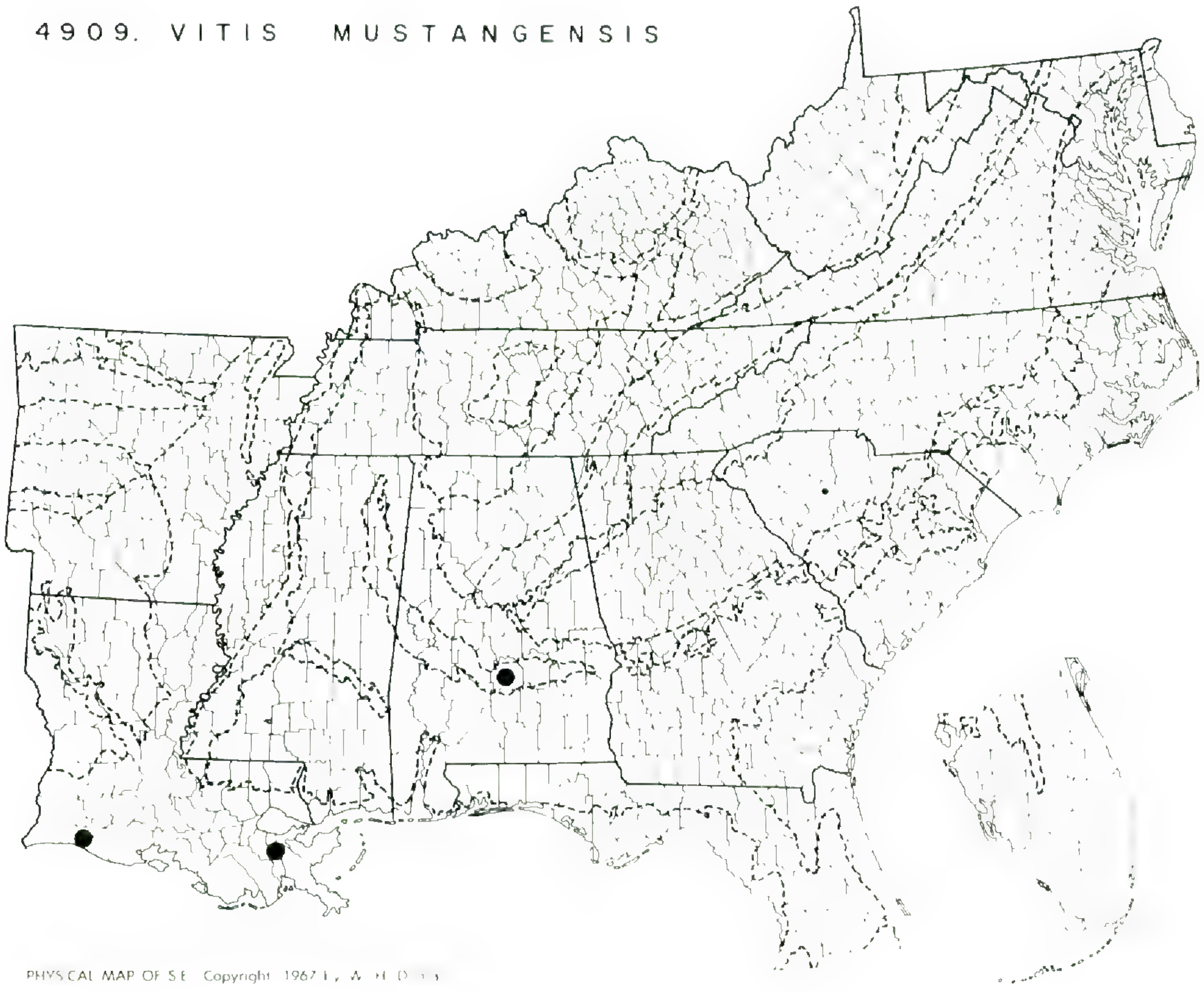

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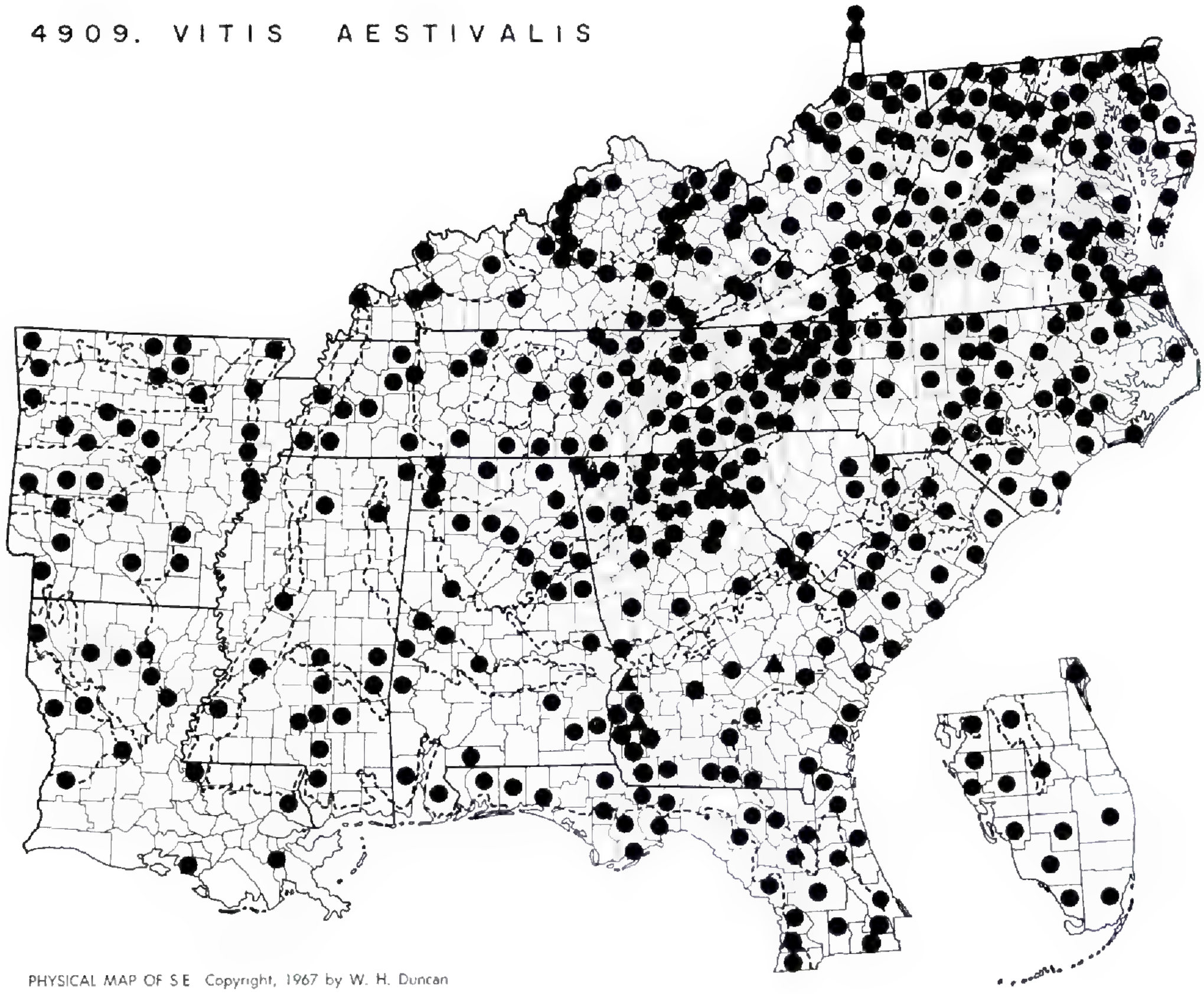

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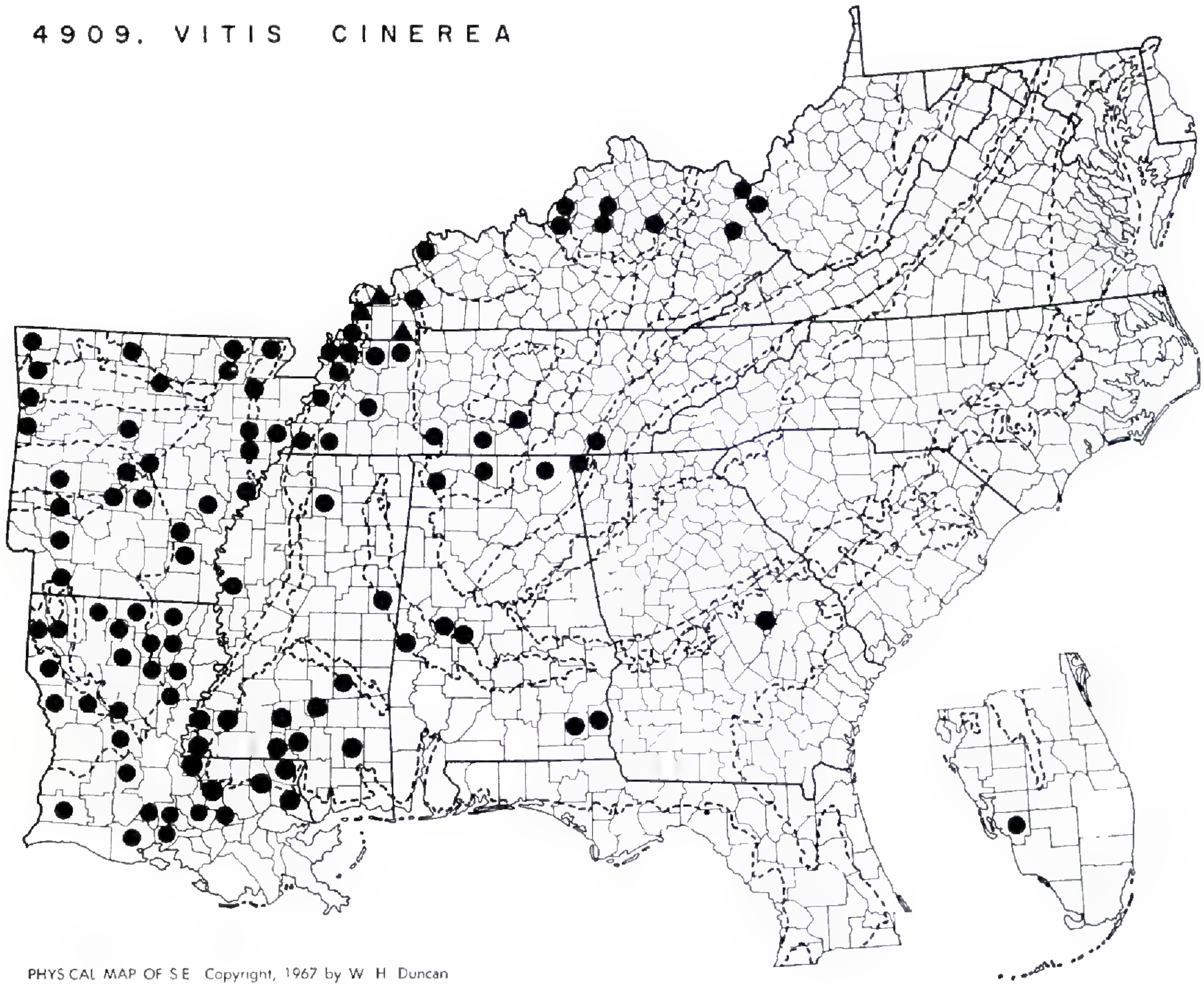

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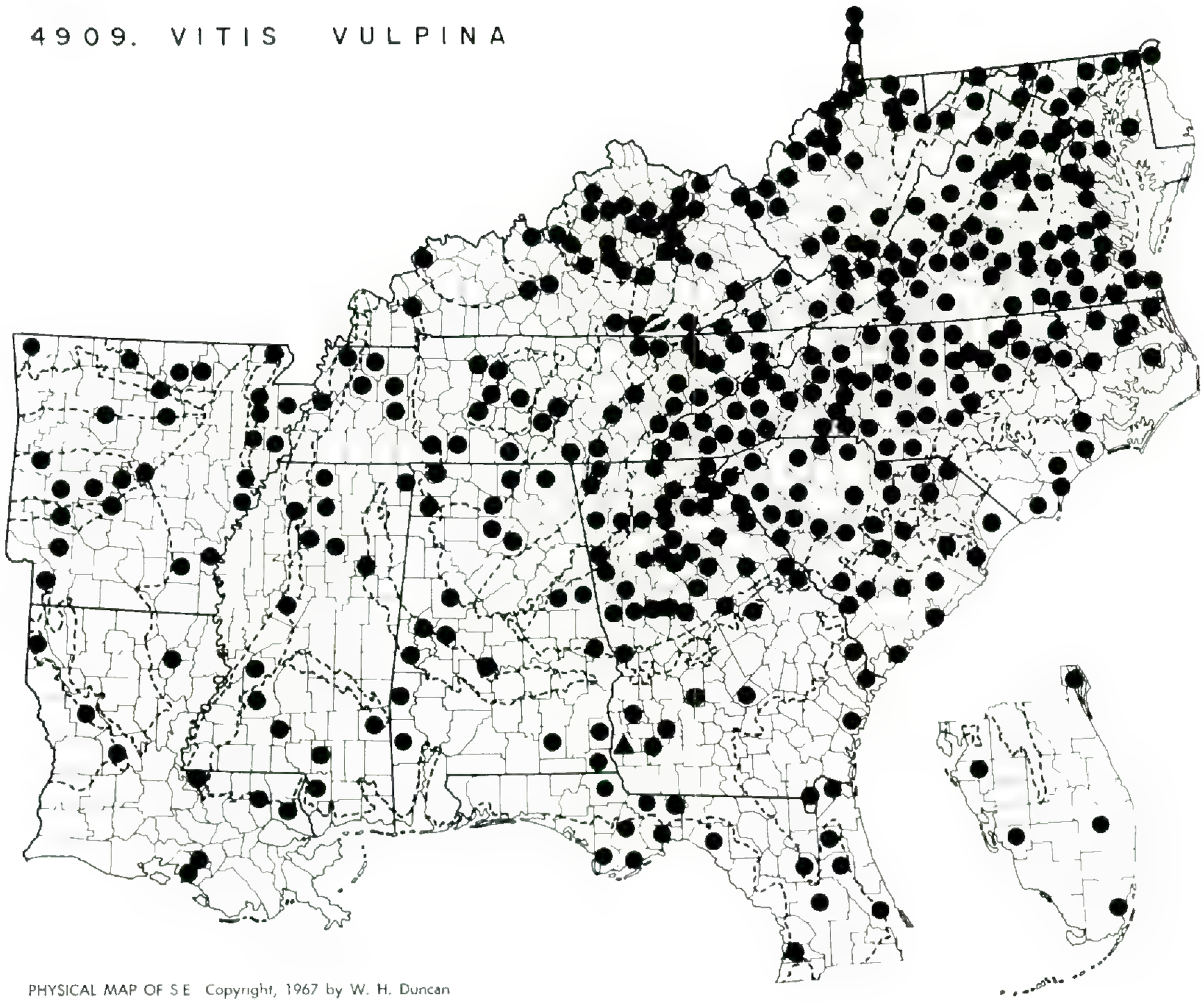

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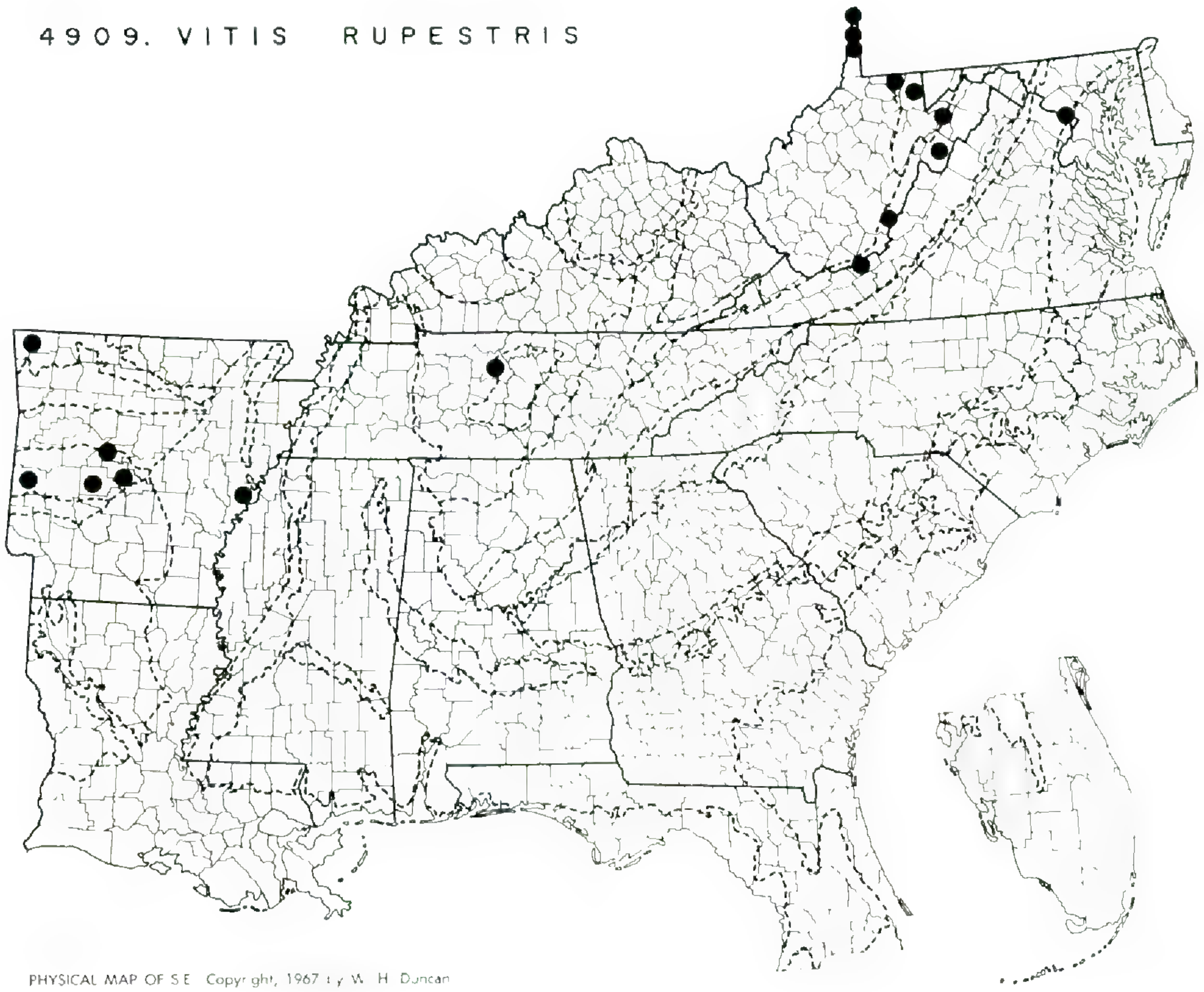

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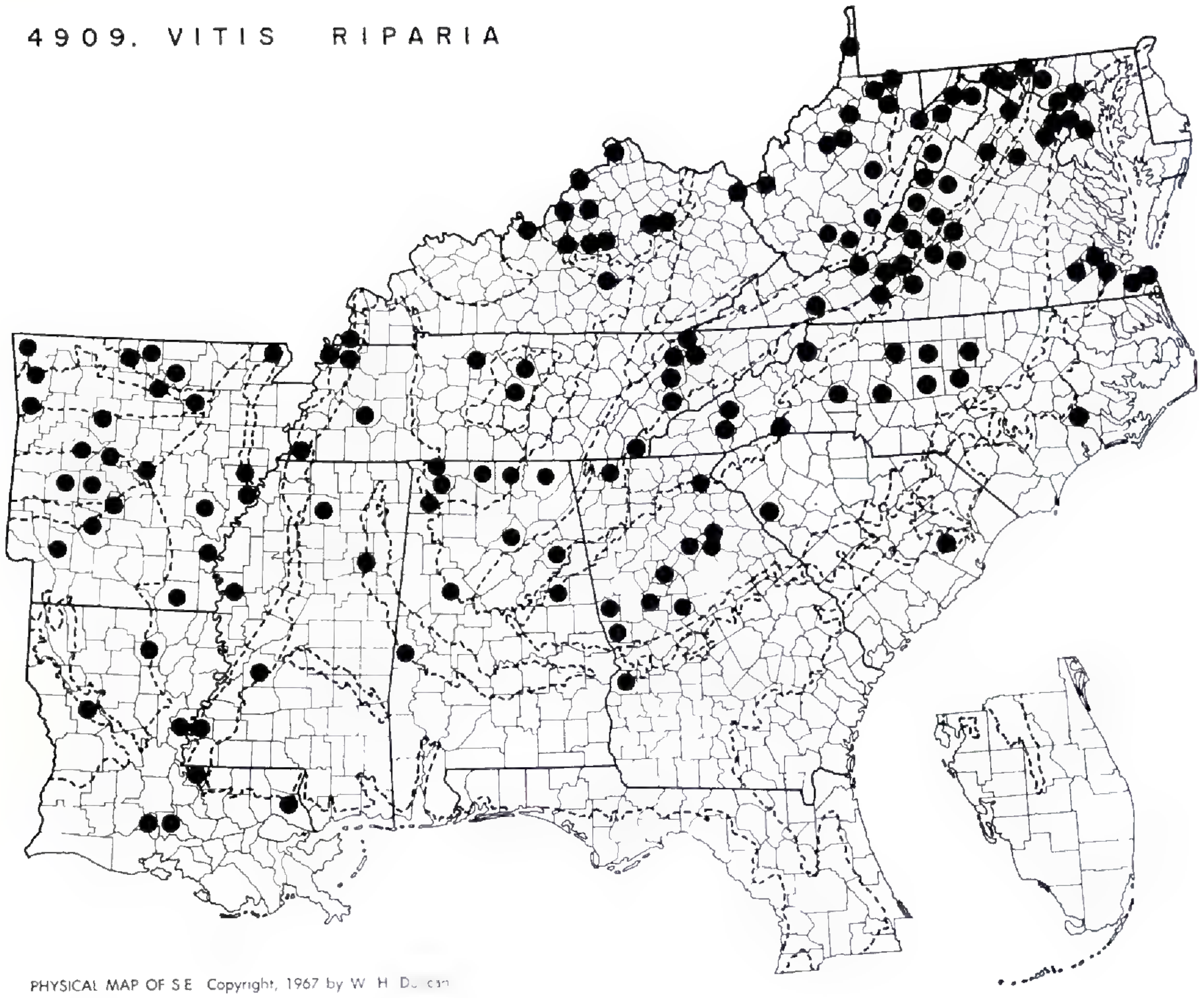

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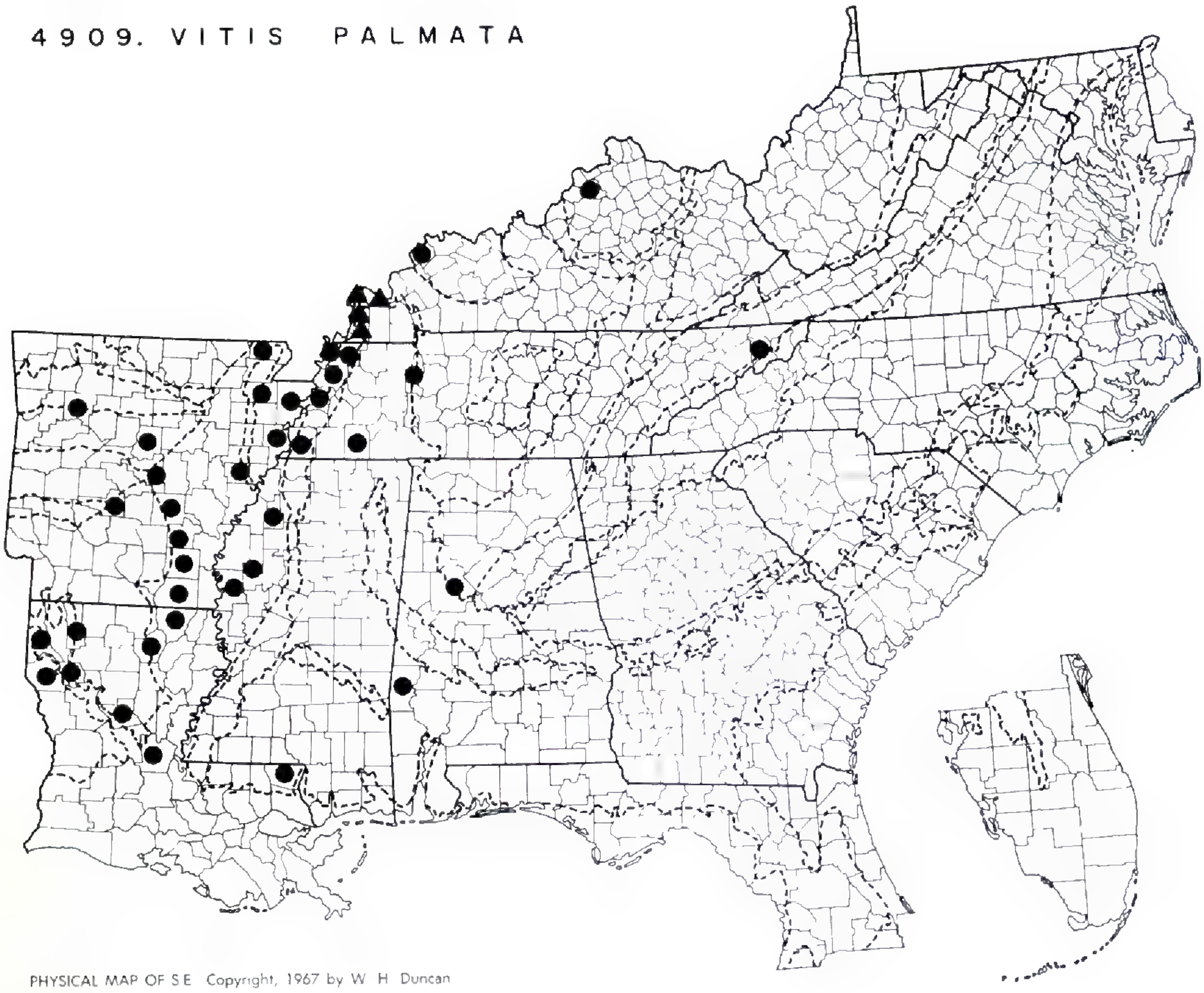

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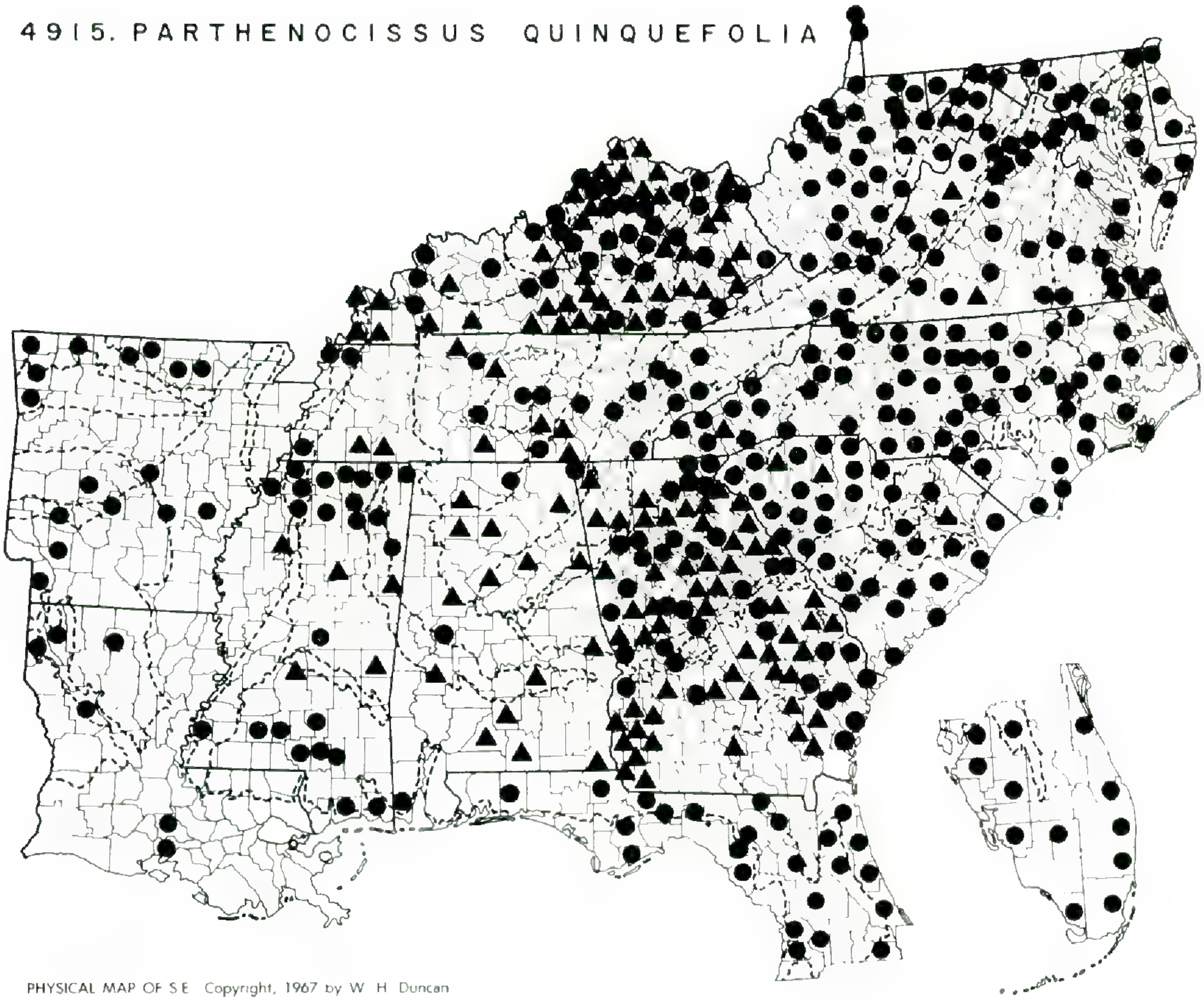

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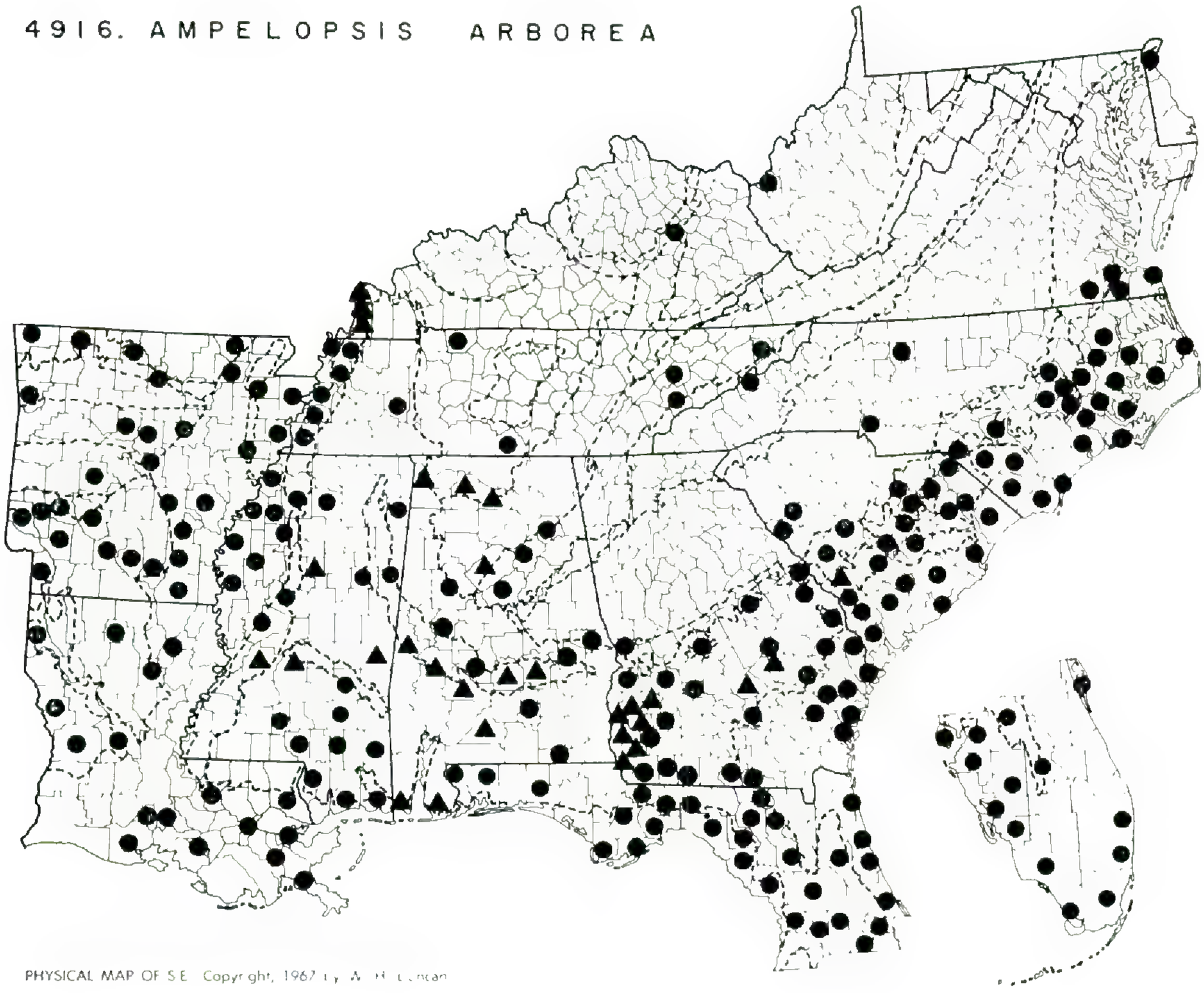
4916. AMPELOPSIS ARBOREA



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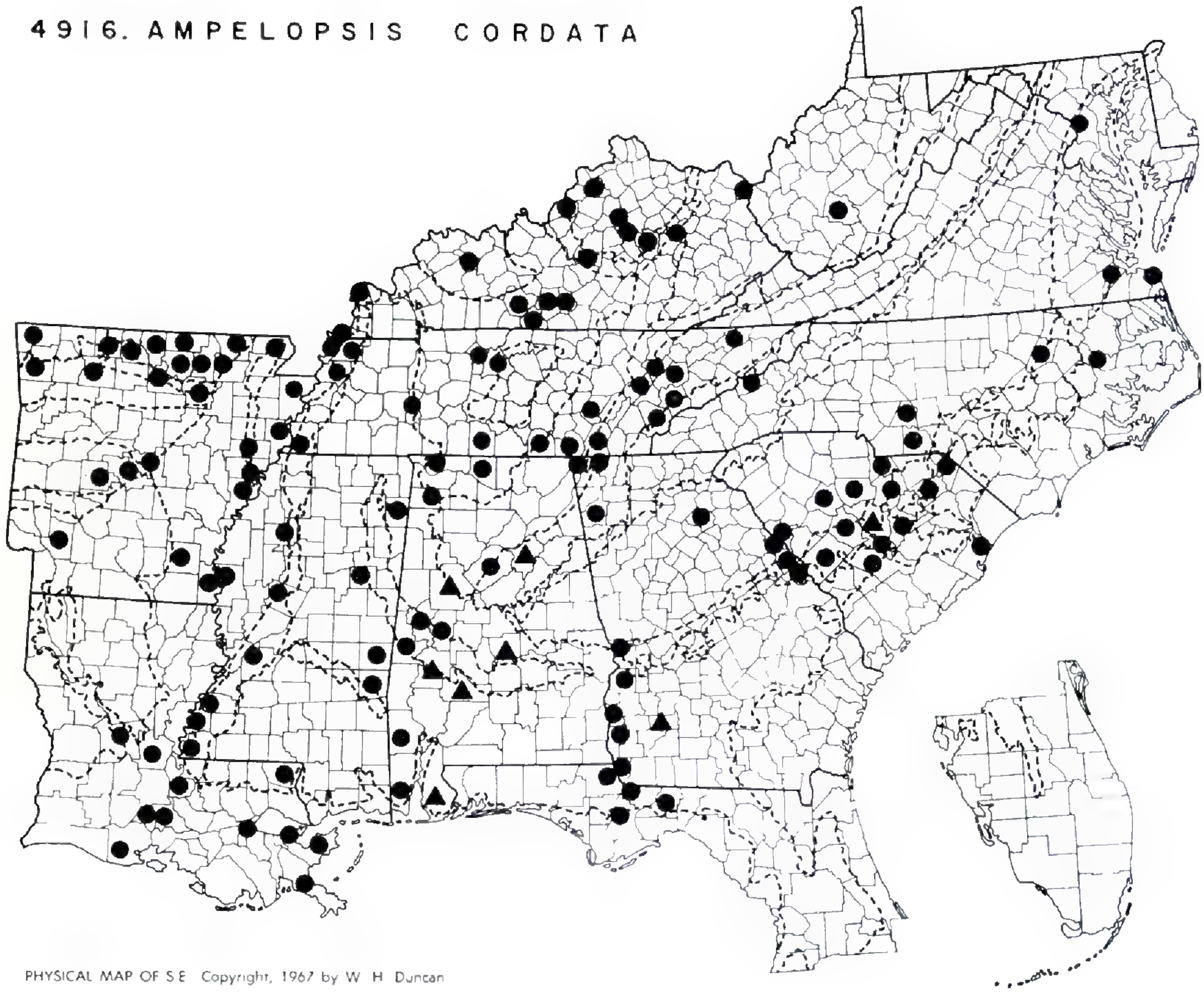
4916. AMPELOPSIS CORDATA



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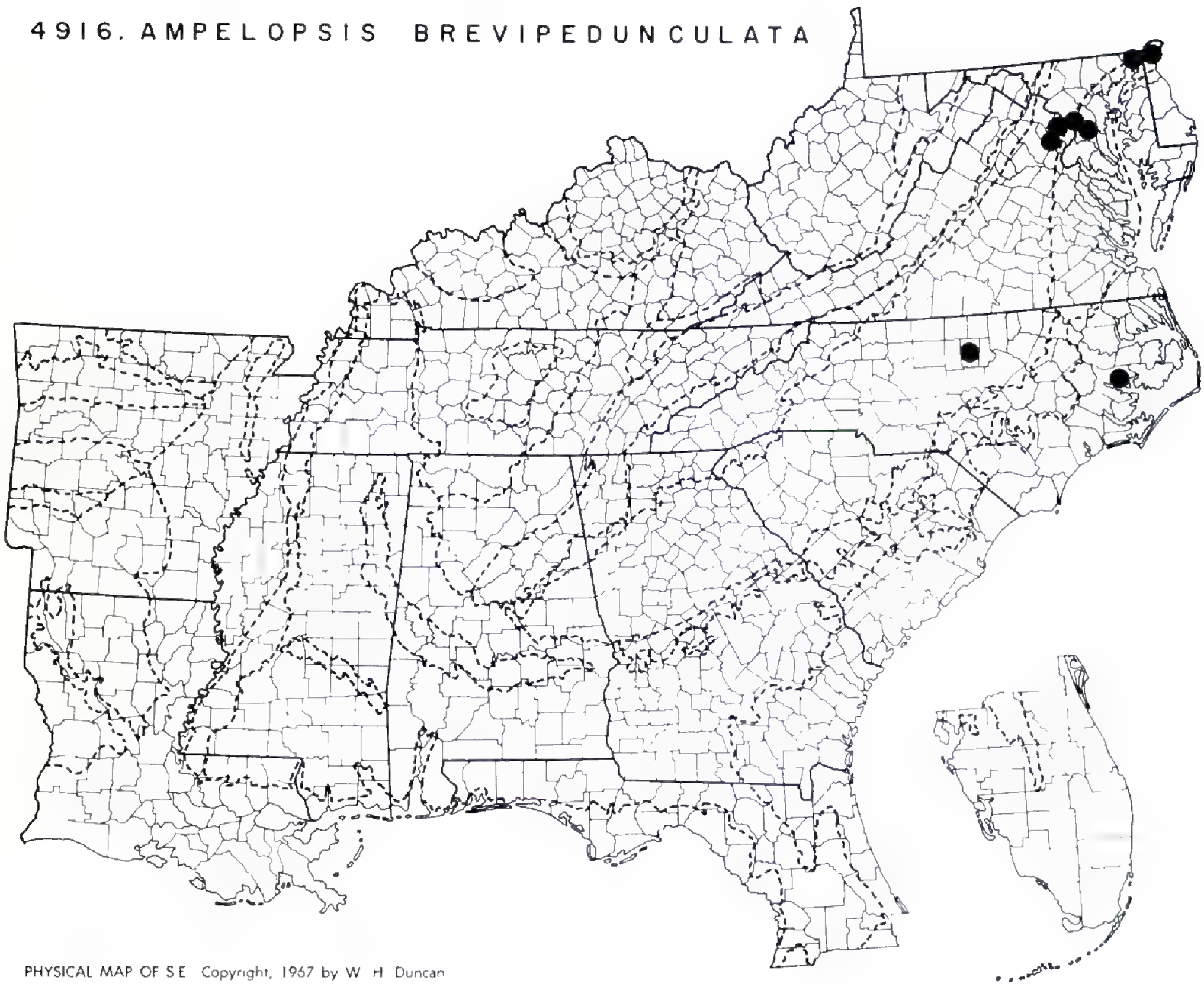

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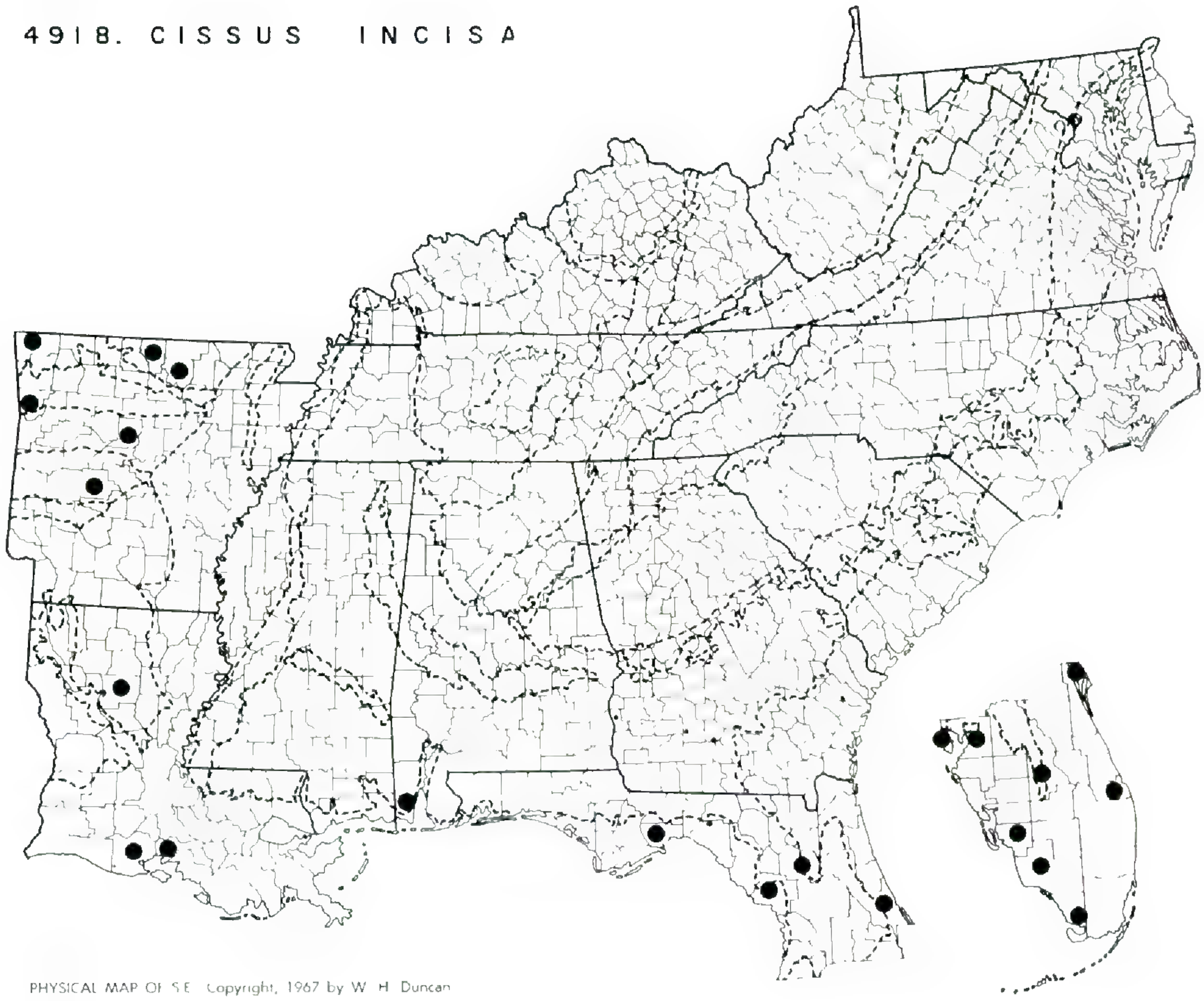

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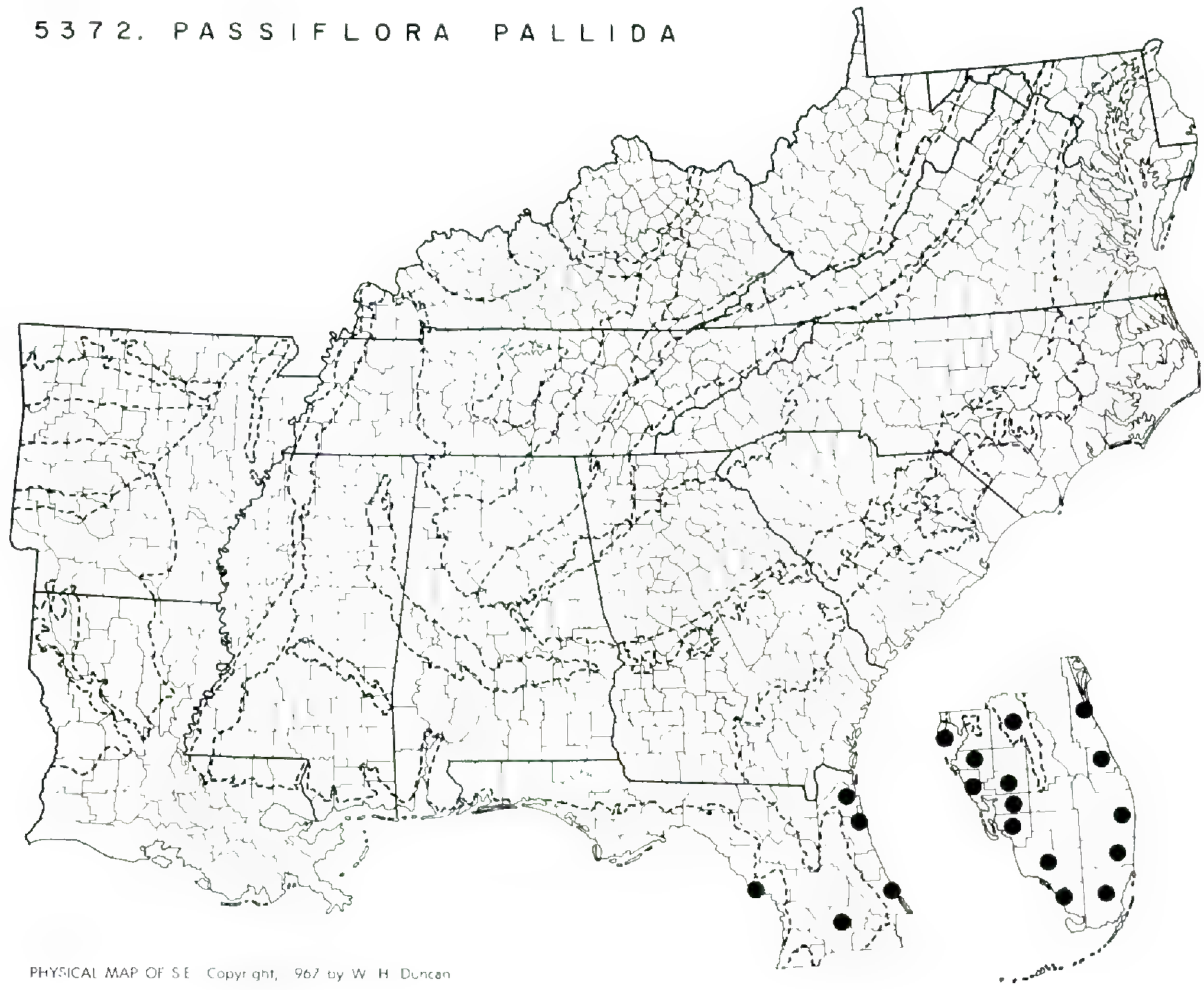
5372. PASSIFLORA PALLIDA



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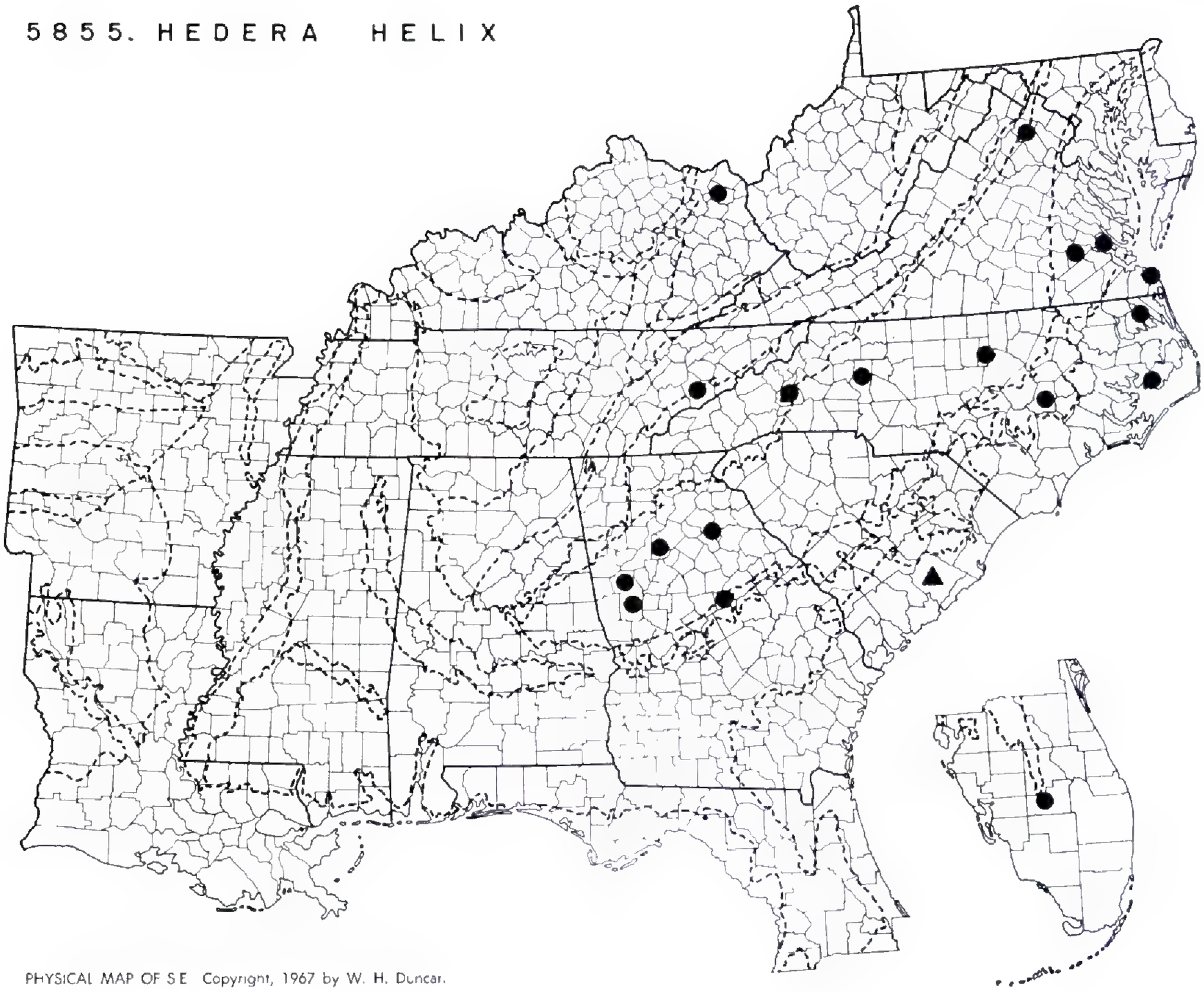
5855. HEDERA HELIX



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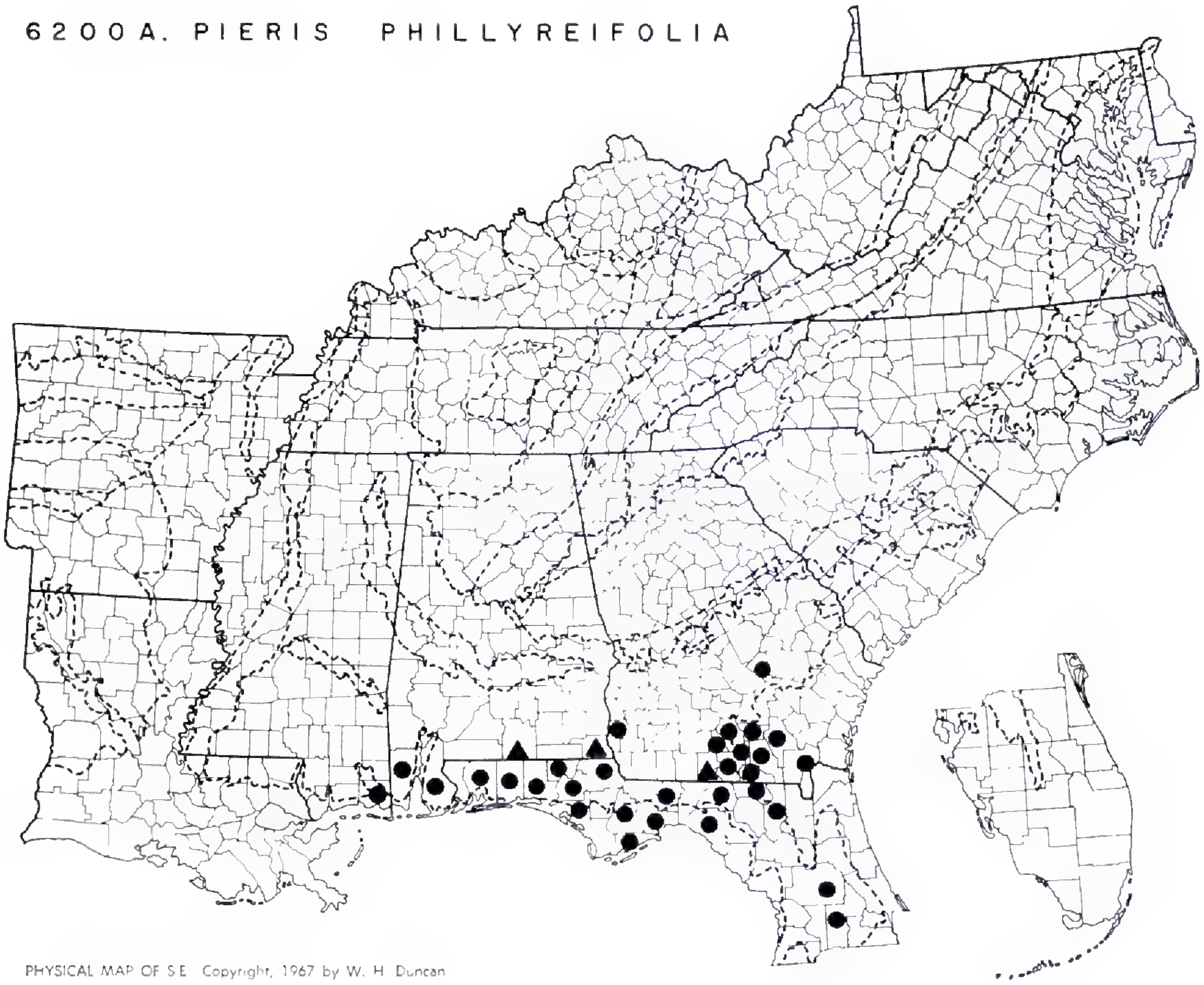
6200A. PIERIS PHILLYREIFOLIA



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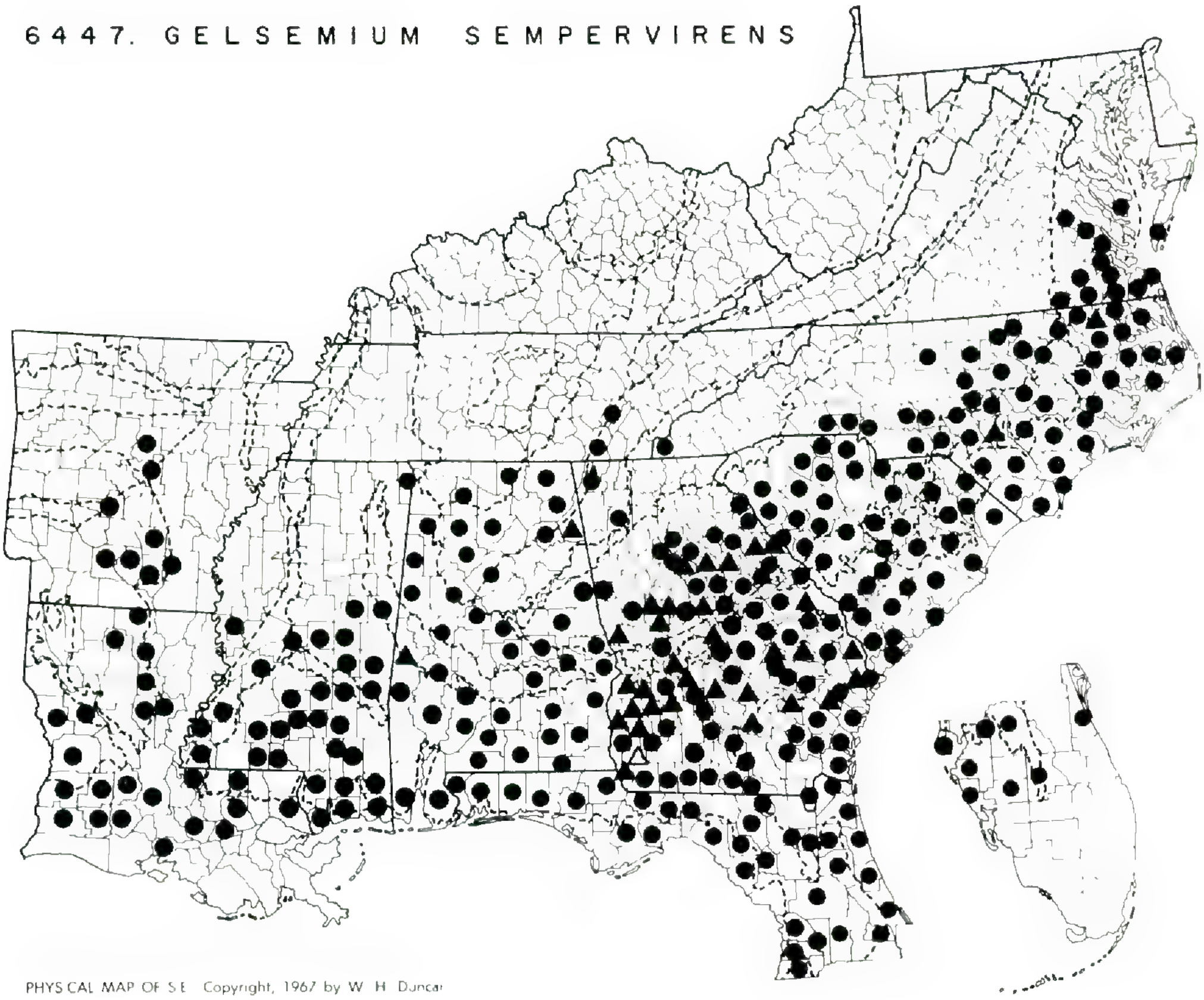
6447. GELSEMIUM SEMPERVIRENS



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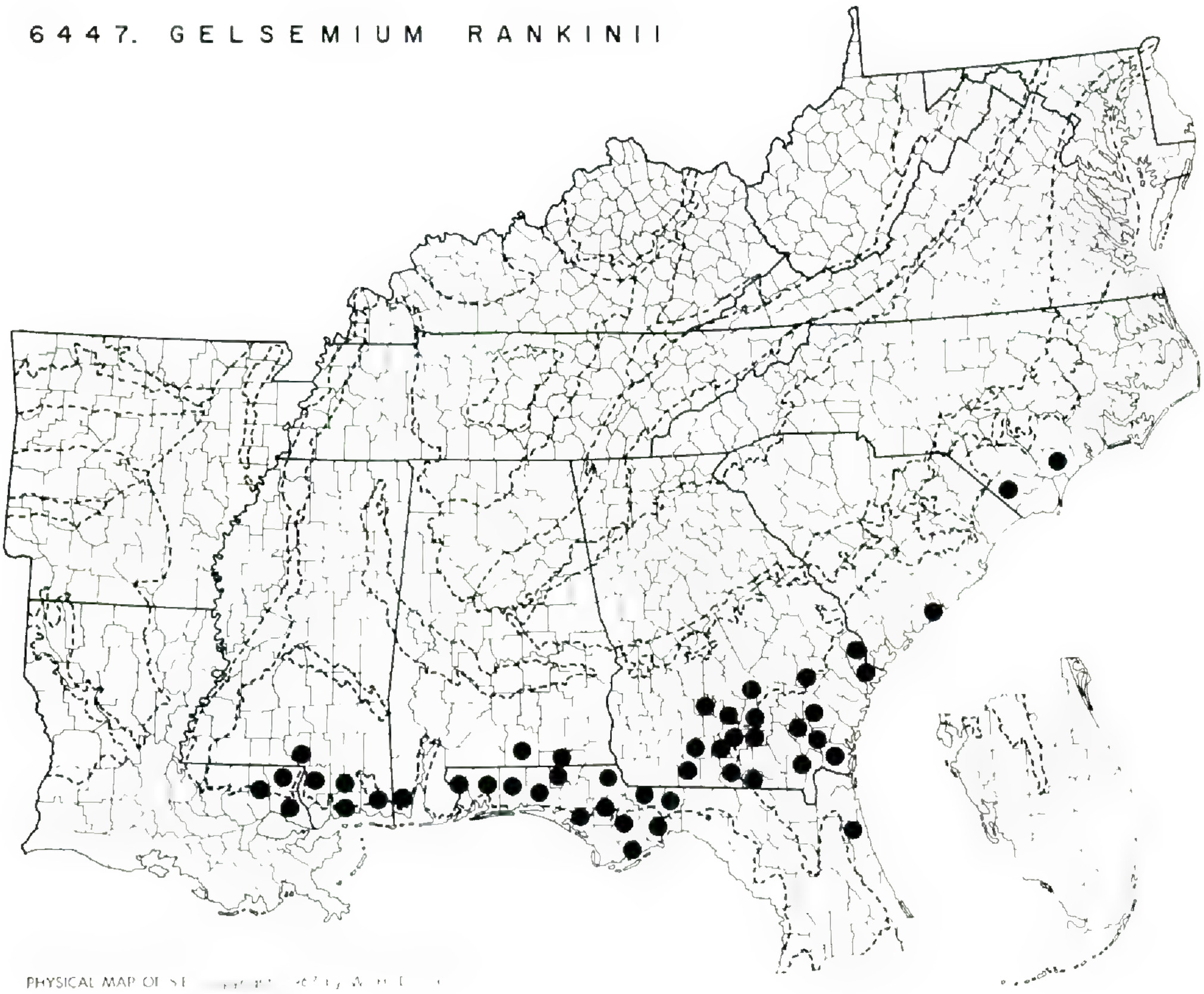

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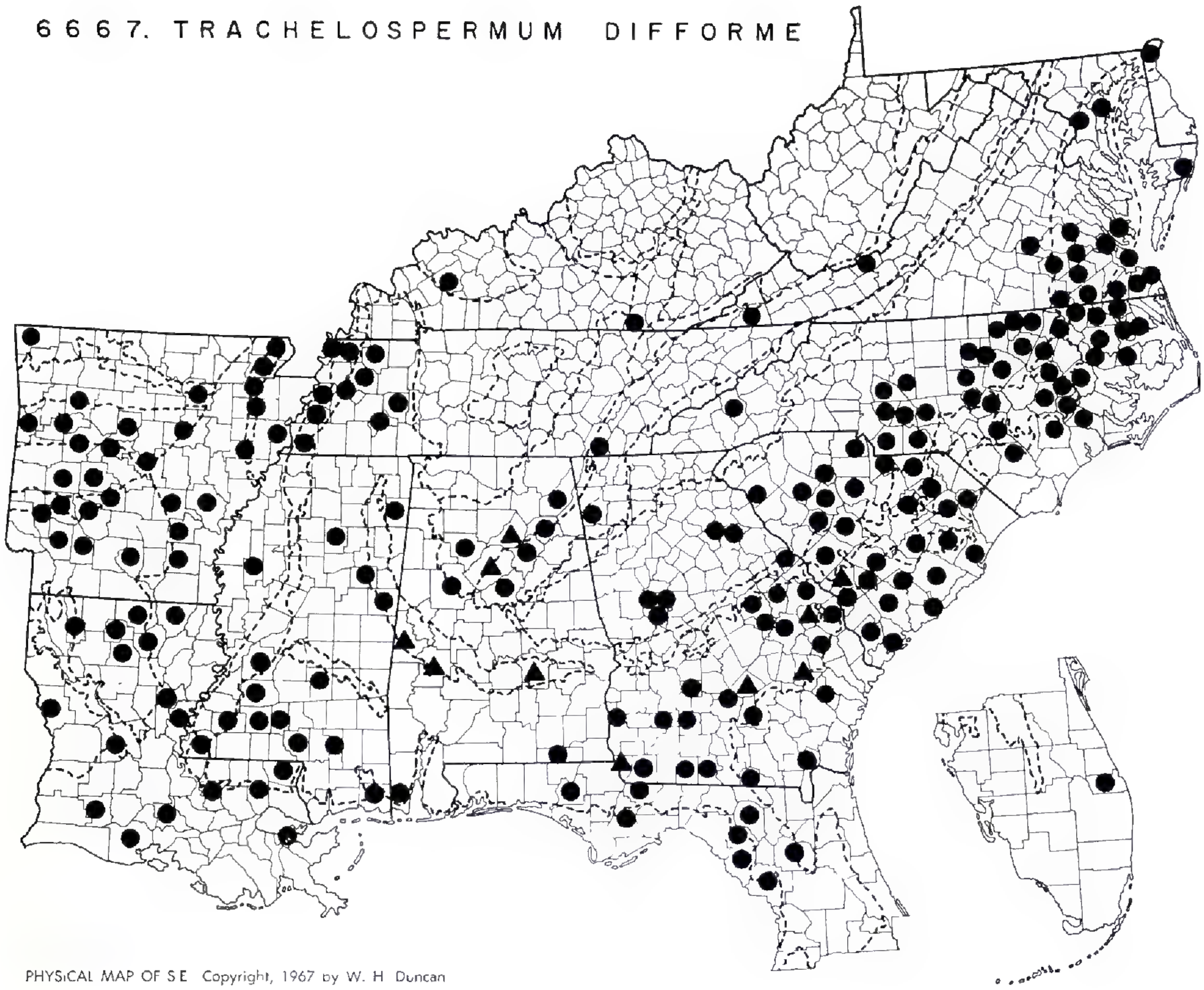
6667. TRACHELOSPERMUM DIFFORME



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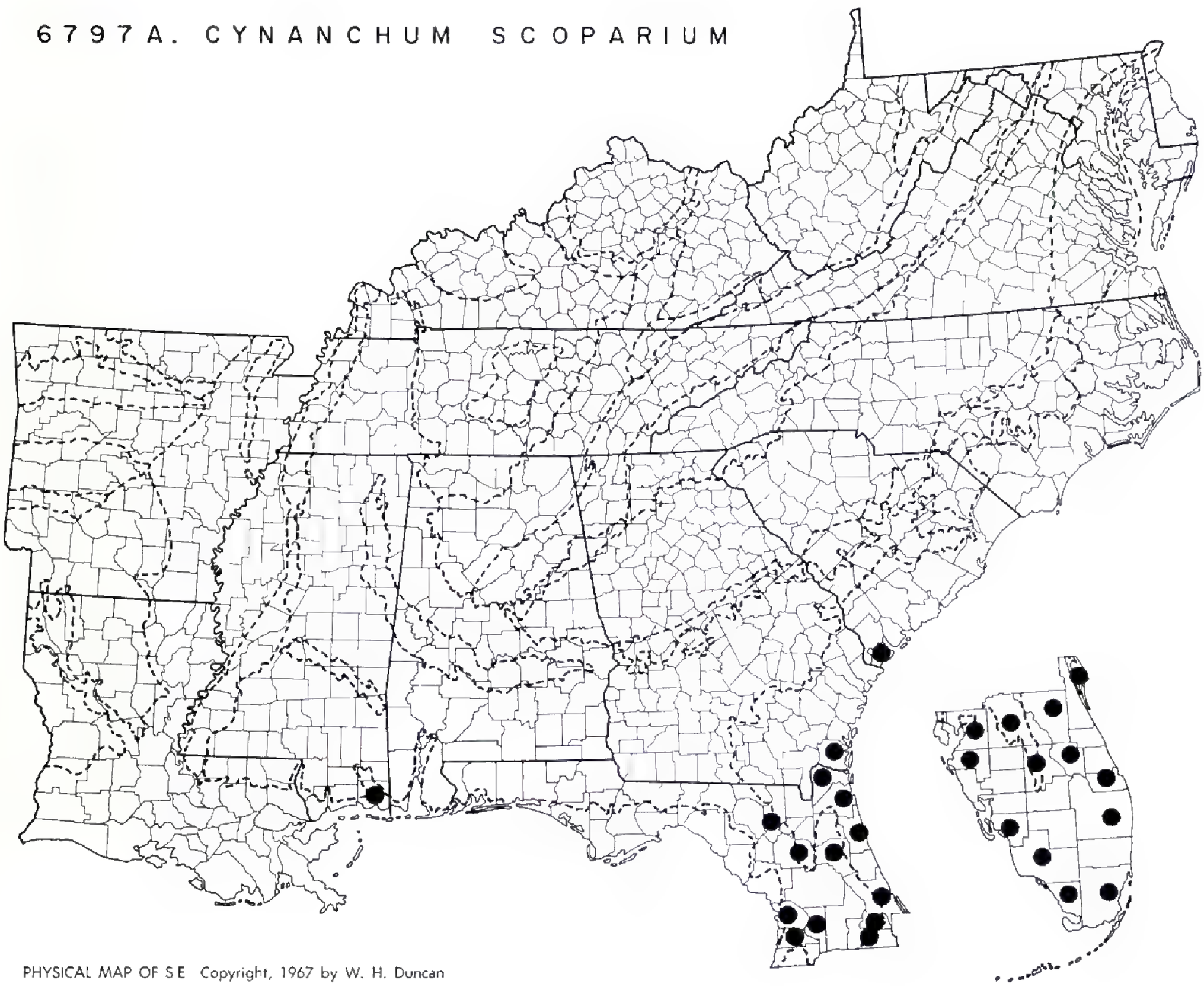
6797A. CYNANCHUM SCOPARIUM



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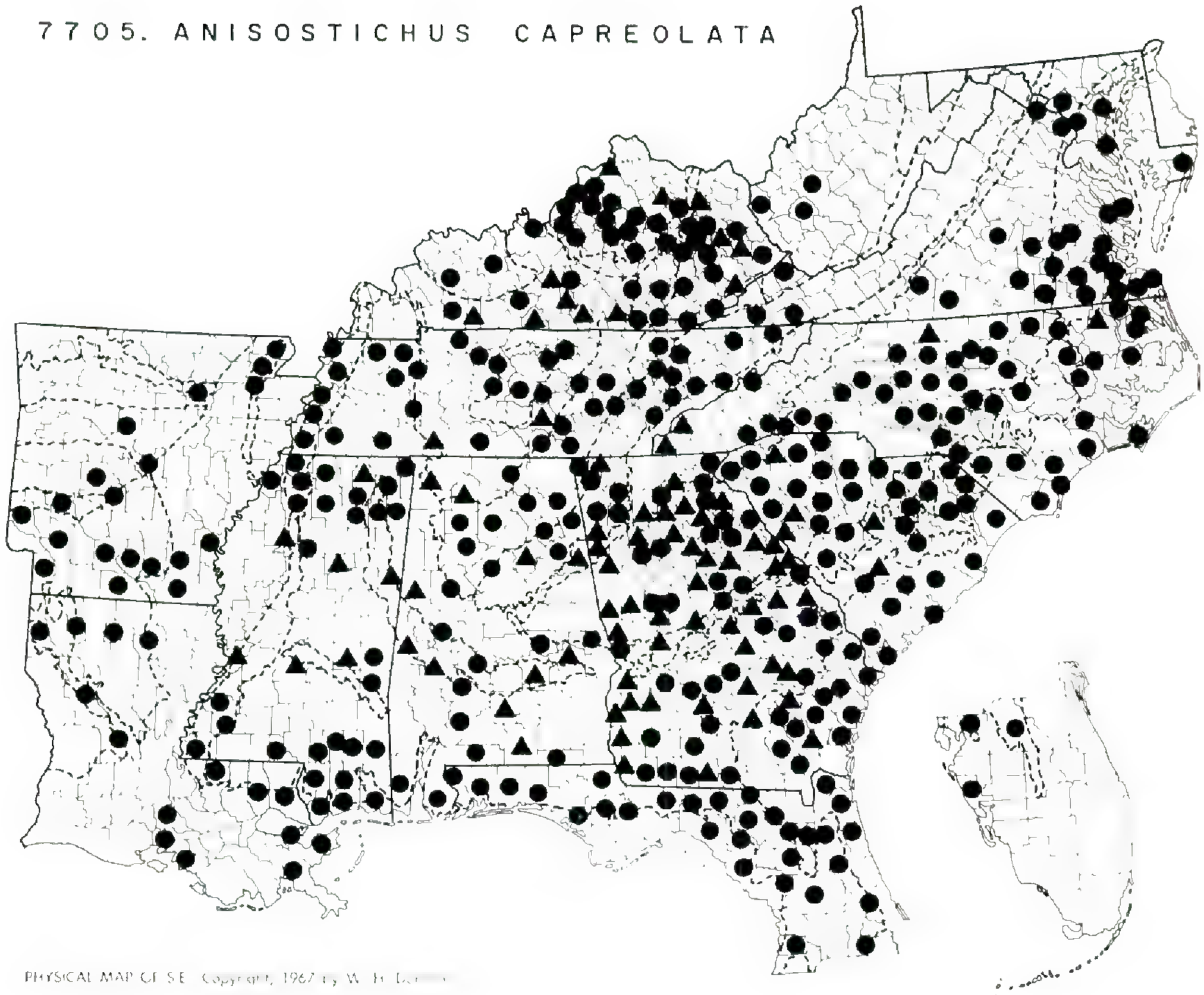
7705. ANISOSTICHUS CAPREOLATA



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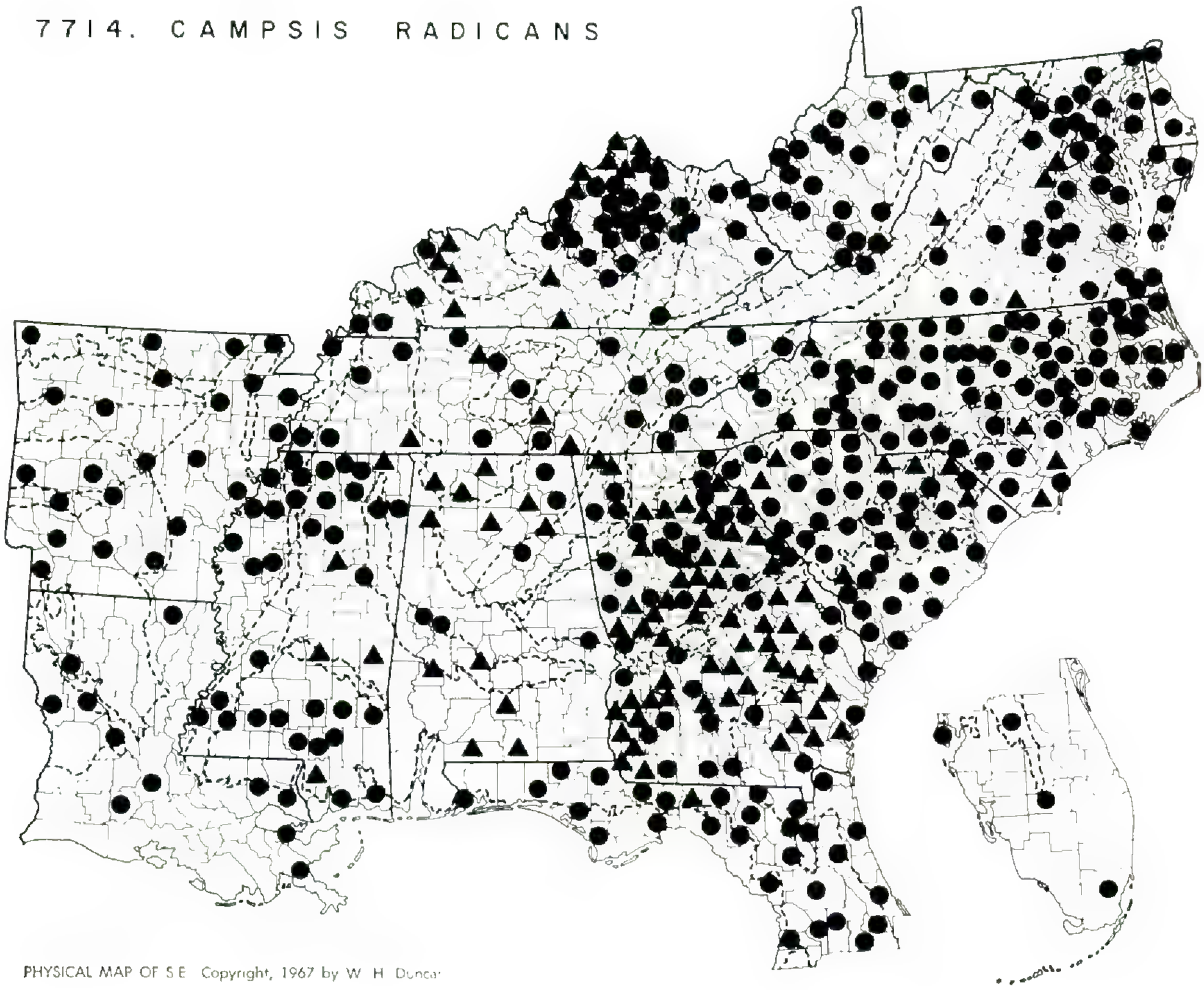
7714. CAMPSIS RADICANS



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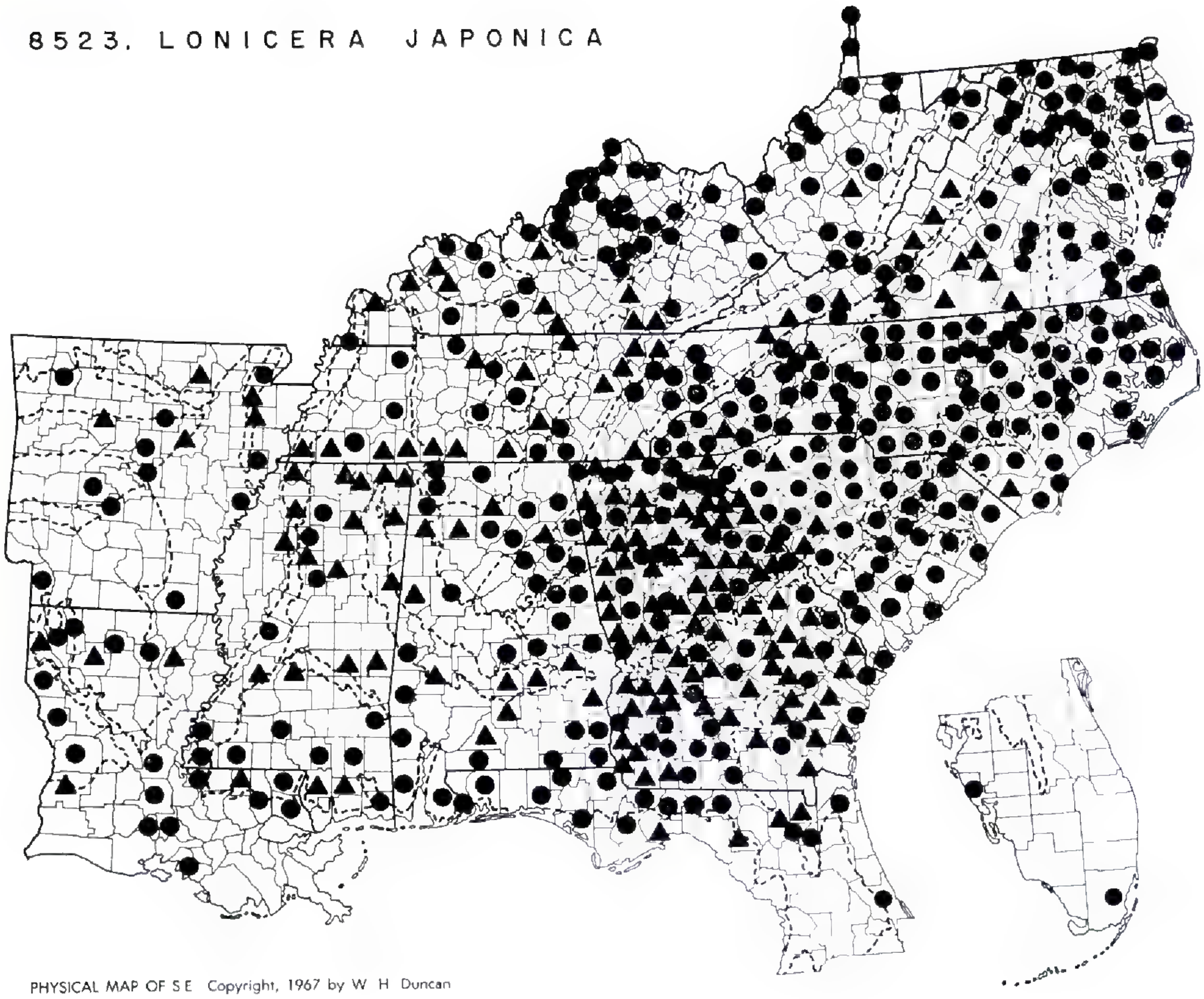
8523. LONICERA JAPONICA



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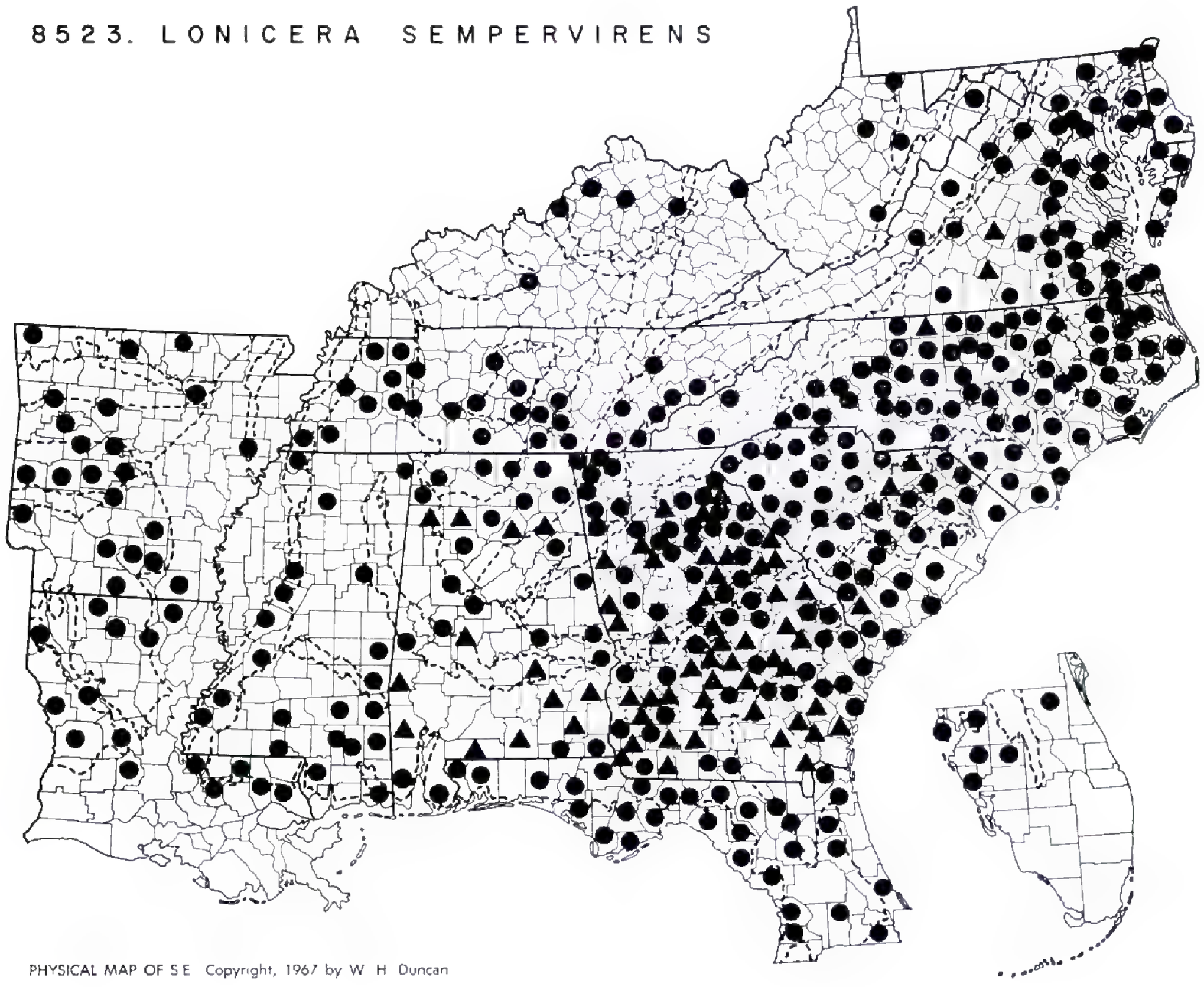

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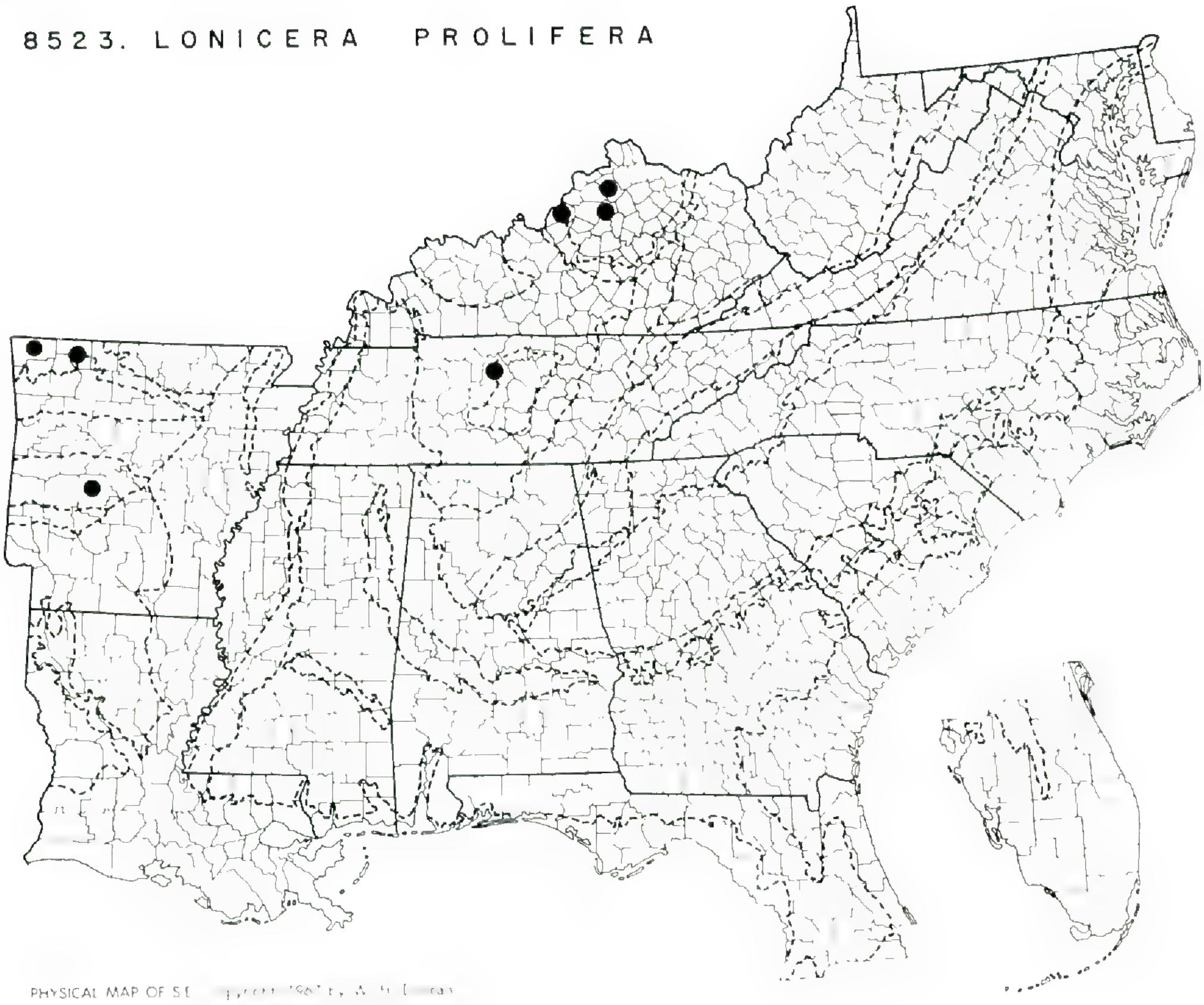
8523. LONICERA PROLIFERA



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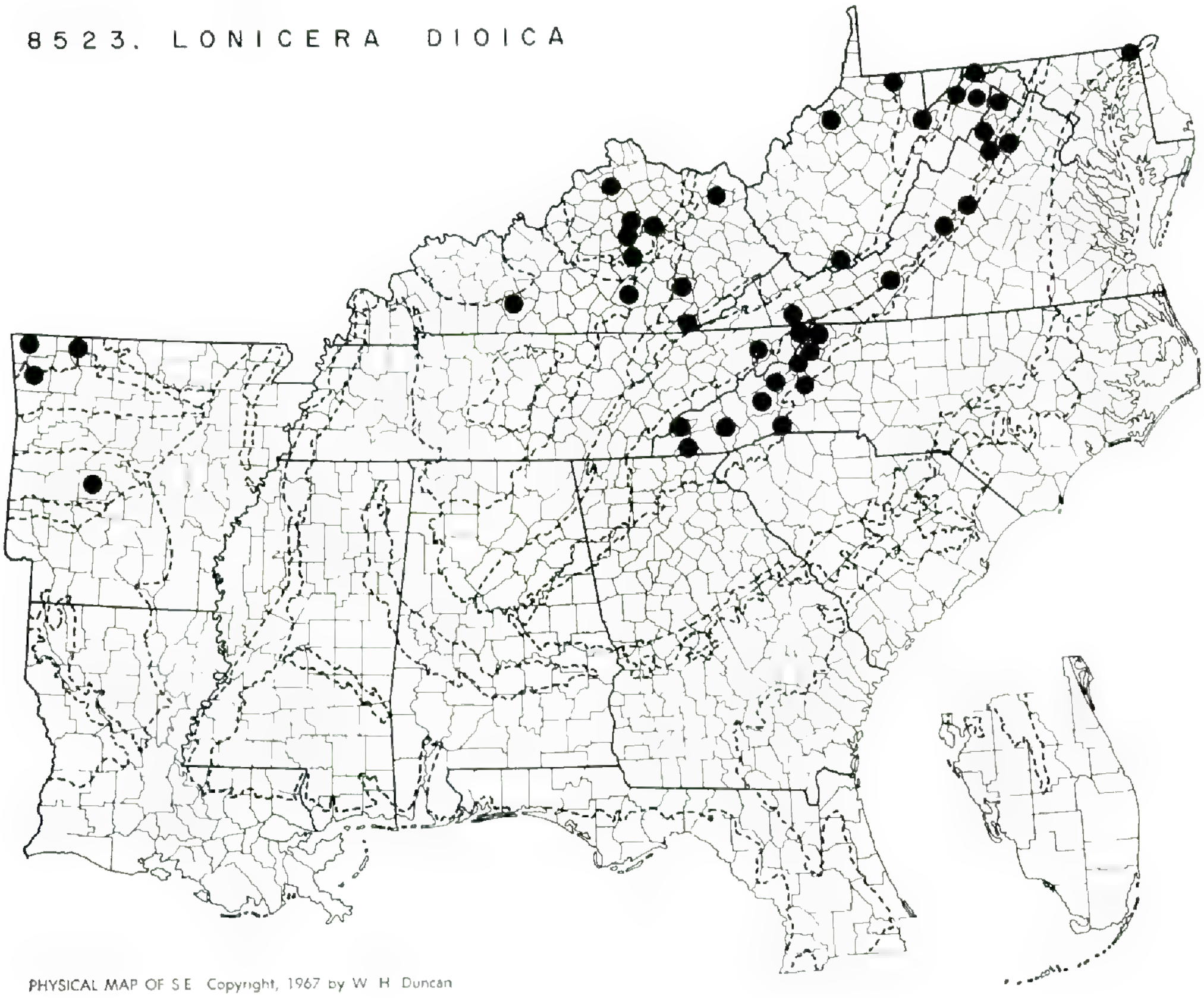
8523. LONICERA DIOICA



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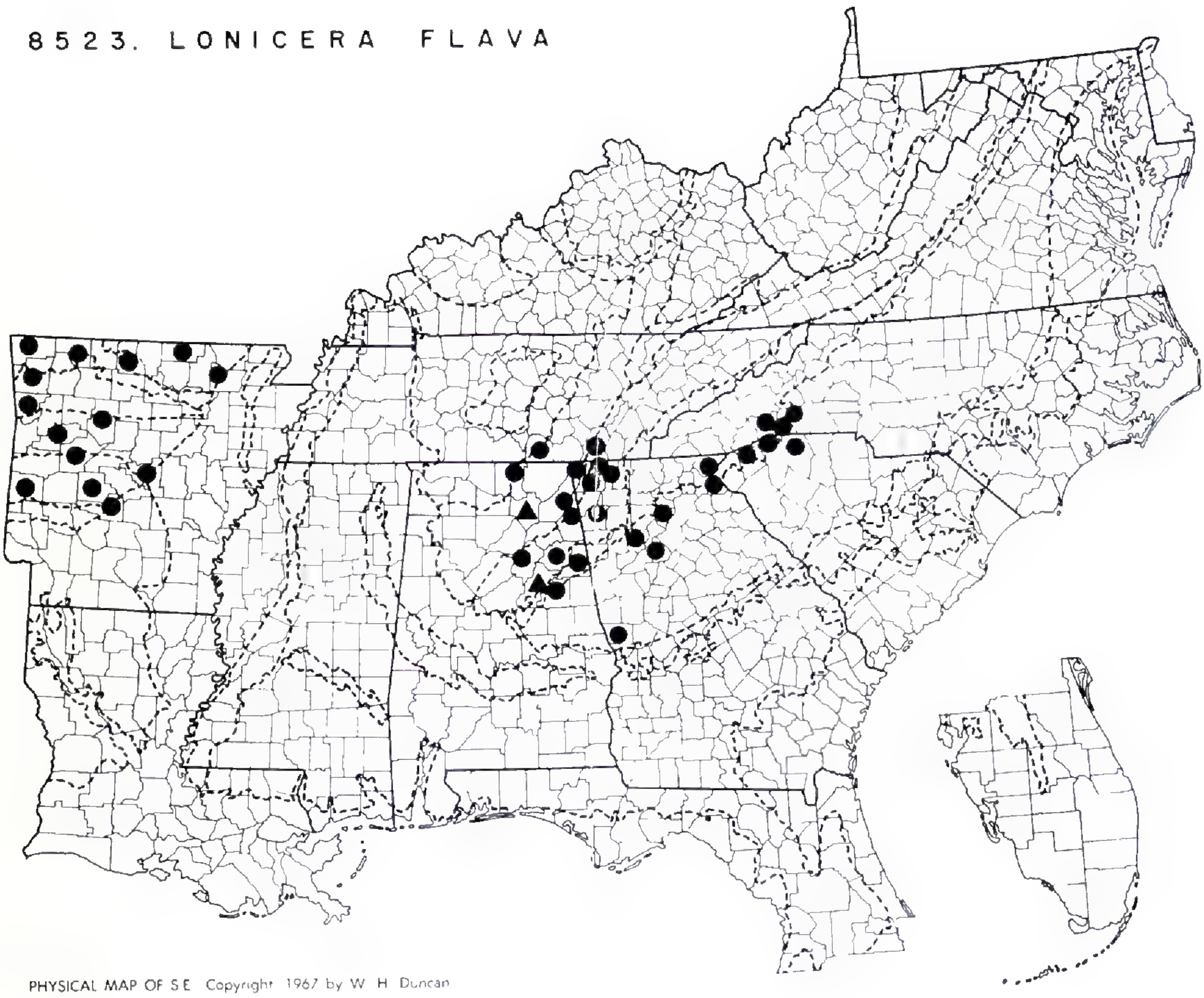

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PILOSTYLES THURBERI (RAFFLESIACEAE) IN TEXAS AND NEW MEXICO

CHESTER M. ROWELL, JR. AND JIMMY L. BLASSINGAME
Department of Biology, Texas Technological College, Lubbock

In the course of investigations of the Genus *Pilostyles*, the authors have greatly expanded the known distribution of this interesting parasitic flowering plant.

Approximately ten collections were known for this plant in Texas when this study began in 1959. Frederick V. Coville made the first known collections in Texas on the Matador ranch, Dickens County, 14 June 1894 (no. 1860) and between Big Spring and Dorwood ranch, Texas, 19 June 1904 (no. 1891). (Coville started a new series of collection numbers each year). These collections were the basis for *Pilostyles covillei* by J. N. Rose (Contrib. U.S. Nat. Herb. 12:263. 1909). Since these early collections, the authors and others have extended the known distribution to 34 counties in Texas with 63 collections; and New Mexico in 2 counties with 3 collections. Despite repeated efforts the plant has not been found in Oklahoma, although both of the host species of *Dalea* occur there. It seems worthwhile to publish these records primarly to encourage others to look for this interesting plant.

Variations have been observed by the authors in the growth patterns of the parasite on the two hosts. The infected plants generally exhibit slight stunting and more profuse branching than adjacent uninfected plants (Fig. 1). The host may exhibit chlorotic tendencies. The parasite occurs in longitudinal rows or dense masses at the base of the stem on *Dalea frutescens* (Fig. 3). On *Dalea formosa*, the parasite may occur in basal masses, longitudinal rows, or solitarily (Fig. 4). The parasite is found primarily on plants growing under marginal or "stress" conditions (usually exposed rocky ledges).

The individual flowers are red-purple to brown-purple in color and approximately 1-3 mm. long and 0.5-2 mm. wide (Fig. 2). The flower is unisexual and usually has four or more sepals without petals. The calyx and subtending bracts are usually white tipped.

The following list is based on specimens deposited at the herbarium of Texas Technological College unless otherwise indicated.

TEXAS COLLECTIONS

On *Dalea formosa:*

Armstrong County	Rowell 8030, 22 Nov. 1959 Rowell 8251a, 2 May 1961 Blassingame 670 & Rowell, 13 June 1966 Blassingame 671 & Rowell, 14 June 1966

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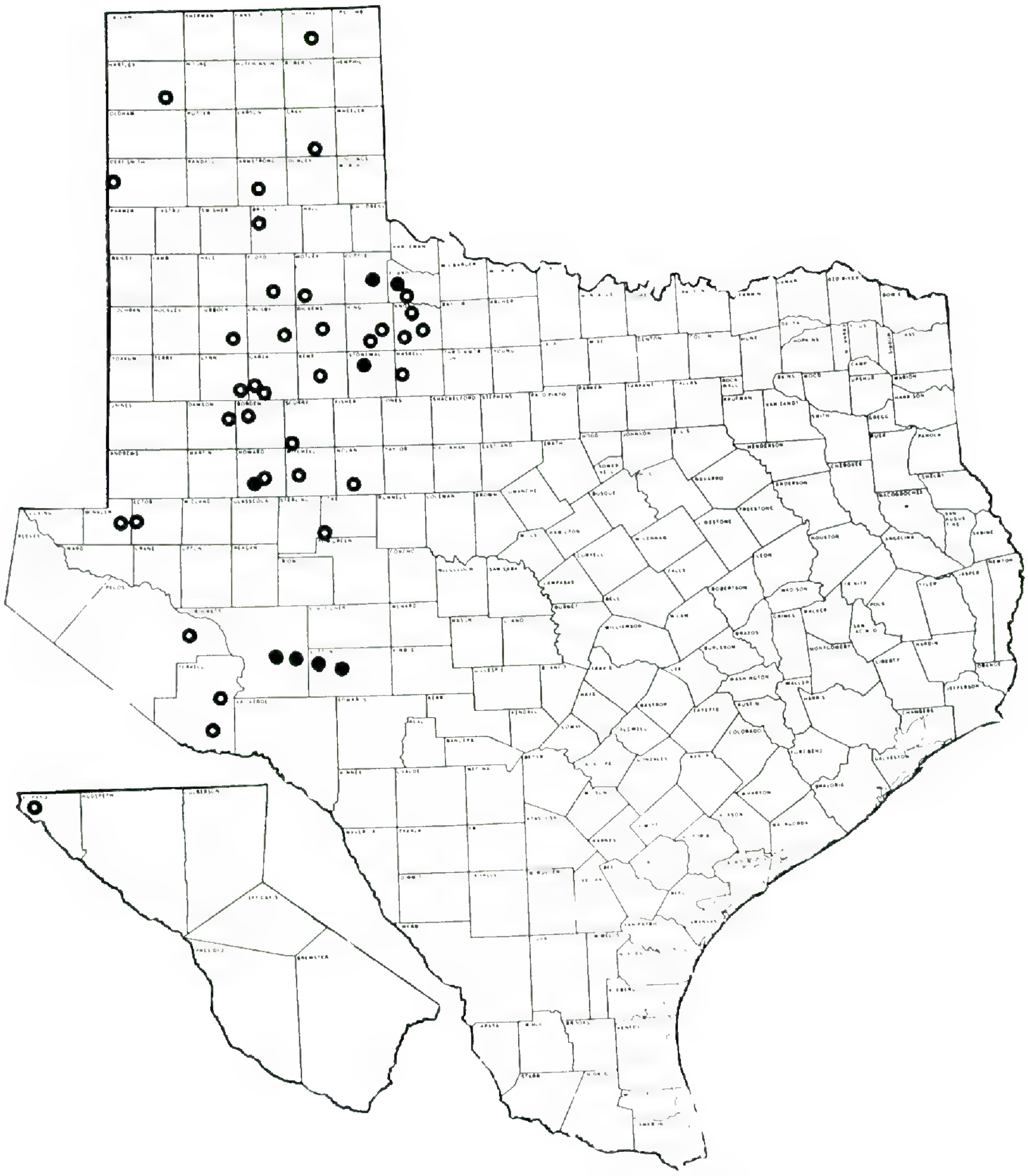

Map 1. County distribution of *Pilostyles thurberi* Gray in Texas. Open circles: on *Dalea formosa;* closed circles: on *D. frutescens.*

Borden County	Blassingame 688 & Stanford, 25 June 1966
Briscoe County	Blassingame 672 & Rowell, 14 June 1966
Coke County	Blassingame 653, 6 June 1966
Crosby County	Blassingame 680, 23 June 1966
Dawson County	Blassingame 690 & Stanford, 25 June 1966
Deaf Smith County	Waller 1031, 3 Aug. 1966
Dickens County	Coville 1860, 14 June 1894 (US)
	Blassingame 675, 15 June 1966
Ector County	Rowell 8784, 4 June 1963
	Blassingame 579, 12 June 1965
	Blassingame 621, 2 June 1966
El Paso County	Warnock 16986 & M. C. Johnston, 25 Oct. 1958 (SRSC)
Foard County	Blassingame 663, 9 June 1966

Floyd County	Rowell 8231a, 18 June 1962
	Blassingame s.n., 19 June 1964
	Blassingame 658 & Rowell, 7 June 1966
Garza County	Rowell 10168, 7 June 1964
	Hutchins 1226 & Blassingame, 16 June 1966
	Hutchins 1227 & Blassingame, 16 June 1966
Gray County	Rowell 10152, 28 May 1964
Hartley County	Blassingame 678 & Rowell, 19 June 1966
Haskell County	Blassingame 666, 10 June 1966
Howard County	Blassingame 656, 6 June 1966
(Howard County)?	Coville 1891, 19 June 1904
Kent County	Blassingame 676, 15 June 1966
King County	Blassingame 681, 23 June 1966
Knox County	Blassingame 664, 9 June 1966
	Blassingame 665, 9 June 1966
	Blassingame 682, 23 June 1966
Lubbock County	Myrick s.n. & Rowell, 4 June 1960
	Blassingame 659 & Rowell, 7 June 1966
Lynn County	Blassingame 687 & Stanford, 28 June 1966
Mitchell County	Blassingame 668, 11 June 1966
Motley County	Blassingame 686, 26 June 1966
Nolan County	Blassingame 667, 10 June 1966
Ochiltree County	Rowell 10373, 5 June 1964
Pecos County	Warnock 17315 & M. C. Johnston, 1 Nov. 1958 (SRSC)
Scurry County	Blassingame 669, 11 June 1966
Terrell County	Warnock 17237 & M. C. Johnston, 1 Nov. 1958 (SRSC)
	Rowell 8252, 6 Aug. 1962
	Blassingame 639, 5 June 1966
	Blassingame 640, 5 June 1966
Winkler County	Rowell 8306, 6 May 1962
	Rowell 8566, 5 May 1963

On *Dalea frutescens:*

Cottle County	Blassingame 661, 9 June 1966
Crockett County	M. C. Johnston 3261, 10 Sept. 1958
	M. C. Johnston 3265, 10 Sept. 1958
	Rowell 8253, 6 Aug. 1962
	Blassingame 647, 5 June 1966
	Blassingame 648, 5 June 1966
	Blassingame 650, 5 June 1966
	Blassingame 651, 5 June 1966
Foard County	Blassingame 662, 9 June 1966
Howard County	Blassingame 657, 6 June 1966
Stonewall County	Blassingame 674, 15 June 1966
Sutton County	M. C. Johnston 3260, 10 Sept. 1958 (SRSC)
	Rowell 6000, 29 May 1959
	Rowell 8763, 3 June 1963
	Blassingame 652, 6 June 1966
(County unknown)	Lindheimer 376 (isotype of *D. frutescens*) (SMU)

NEW MEXICO COLLECTIONS

On *Dalea formosa*

Guadalupe County	Blassingame 691 & Rowell, 5 Aug. 1966
San Miguel County	Rowell 8551, 3 May 1963
	Blassingame 692 & Rowell, 7 Aug. 1966
	Blassingame 693 & Rowell, 7 Aug. 1966

Fig. 1. (upper) Habitat photograph of *Dalea formosa* with infected plant on right.

Fig. 2. (lower) Detail photograph of *Pilostyles* flowers.

Fig. 3. (upper) Photograph of *Pilostyles* on *Dalea frutescens.*

Fig. 4. (lower) Photograph of *Pilostyles* on *Dalea formosa.*

NOTES ON ERIOGONUM—II. VARIATION IN ERIOGONUM ATRORUBENS

JAMES L. REVEAL[1]

Department of Botany, Brigham Young University, Provo, Utah 84601

The subgenus **Pterogonum** (H. Gross) Reveal (comb. nov., based on *Pterogonum* H. Gross, Bot. Jahrb. 49: 239. 1913) forms a natural group of eight species which may be divided into two sections. Since *E. atrorubens* Engelm. in Wisliz. was described in 1848, the various authorities on the genus have placed it, and its related species, into two separate subgenera, distinguished by the presence or absence of winged achenes. The various treatments of *Eriogonum* until 1936 proposed that the known species with winged achenes, *E. atrorubens*, *E. alatum* Torr. and *E. hieracifolium* Benth. in DC., be placed in the subgenus *Eriogonum*, while the related, non-winged species, *E. ciliatum* Torr. ex Benth. in DC. and *E. greggii* Torr. & Gray, were placed in the subgenus *Ganysma* (S. Wats.) Greene. *Eriogonum nealleyi* Coult., while having winged achenes similar to those of *E. hieracifolium*, has been associated with species of the subgenus *Ganysma*. Unlike most of the Stokes monograph, *The Genus Eriogonum* (1936), the treatment of these species is excellent, and she points out their close affinities by placing them together in her Section 1A.

A recent review of type material at the University of California, Missouri Botanical Garden, U. S. National Herbarium, New York Botanical Garden, and the Gray Herbarium and Arnold Arboretum at Harvard University has allowed for a detailed examination of nearly all of the types in *Pterogonum*, and during this study, two undescribed varieties of *E. atrorubens* were discovered.

ERIOGONUM ATRORUBENS Engelm. in Wisliz., Mem. Tour North. Mex. 108. 1849.

Tall, erect, perennial herbs, 5-8 (-10) dm. high, glabrous and glaucous; leaves basal, the blades oblanceolate, lanceolate, or oblong to elliptic, (2.5-) 4-8 (-10) cm. long, (0.5-) 1-3 cm. wide, sparsely strigose on both surfaces, often more densely so below than above, or glabrous except for ciliated margins and midveins, or densely white-tomentose below and strigose above, petioles 3-8 (-12) cm. long, winged, expand-

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[1] The author is grateful to the Smithsonian Institution and the U. S. National Herbarium which sponsored his Predoctoral Internship program in Washington, D.C., from September 1966 to February 1967, where this paper was prepared. Mr. William Hess of the University of Oklahoma has kindly read and made several helpful comments and suggestions on the manuscript and proposed treatment. The assistance of C. V. Morton, U. S. National Herbarium on various aspects of this paper is acknowledged. He also wishes to express his thanks to the curators of the various herbaria who sent loan material or whose facilities were visited during the course of this study.

Notes on Eriogonum—I appeared in Leafl. West. Bot. 10: 334—335. 1966.

ing into broad petiole bases 3-7 mm. wide, glabrous to sparsely strigose or tomentose, especially along the margins and midveins; stems usually solitary, 1-4 dm. long, often inflated slightly below the first node, di- or trichotomously divided above, the branches erect and spreading with an involucre-bearing peduncle in the forks of each node; bracts scale-like or nearly so, 1-4 (-10) mm. long, linear-lanceolate, ternate, connate at the base, glabrous without, sparsely pilose to strigose within and along the margins and connate base; peduncles erect, straight or curving upward with a slight upward bend about three-quarters of their length from the base, (1-) 2-6 (-12) cm. long; involucres turbinate, 1.5-4 (-4.5) mm. long, 1-2.5 (-3) mm. wide, glabrous without, sparsely ciliated along the margins within, glabrous below, the 5 lobes rounded to truncate, or acute, dividing the tube mostly less than 1/3 its length, pedicels glabrous, reddish, 2-5 (-6) mm. long, curving downward outside the involucre after the perianth has fallen, bractlets linear-oblanceolate to lanceolate, 2-3.5 mm. long, 20-40 flowered; perianth purple to red or maroon, often with a dark greenish midrib, 1.5-2.5 (-3) mm. long in anthesis, glabrous except for the minute scattered white tack-shaped, multicellular, glands that are sessile or short-stalked, the calyx-segments similar, broadly spathulate to obovate, connate only at the bases, acute to rounded at the apices; stamens 2-2.5 mm. long, filaments glabrous, anthers red to yellow, oblong, 0.6-0.8 (-1) mm. long, 0.3-0.6 (-0.7) mm. wide, pollen grains yellow to golden-yellow, oblong; perianth up to 6 mm. long in fruit and the segments closely appressed to the achene in some; achenes winged or nearly so, 4-5 mm. long, light greenish-brown to brown, ovate, the wide, winged bases tapering gradually upward to the short beaked, or beakless, apices.

Infrequent, but locally common, in Pinyon-Juniper woodlands, open meadows, and exposed areas in the low foothills and mountains of Nuevo Leon and adjacent Coahuila, westward to Zacatecas and Durango, and northward in the Sierra Madre Occidental through Chihuahua, Mexico to just south of the United States boundary opposite the extreme southwestern corner of New Mexico.

ERIOGONUM ATRORUBENS VAR. ATRORUBENS

Pterogonum atrorubens H. Gross, Bot. Jahrb. 49: 239. 1913.

Leaves strigose on both surfaces, often slightly more densely below than above.

TYPE: MEXICO: CHIHUAHUA: On the banks of streamlets at Cusihuiriachic (spelled Cosihuiriachi in the original publication), collected in September, 1846 by *A. Wislizenus 172* MO! Isotype GH. Fragments and drawings at NY.

Representative specimens:

MEXICO: COAHUILA: Santa Rita, 21 Aug 1948, *Kenoyer & Crum 2994* (GH); s of Saltillo, 25 Jul-1 Aug 1880, *Palmer 1175* (GH, NY, US); s of Saltillo, 10-13 Jul 1934, *Pennell 17324* (PH, US); e of Fraile, 12

Jul 1941, *Stanford et al.* 359 (NY). CHIHUAHUA: Cajurichi, 13 Sep 1936, *Gentry 2709* (GH, US); Pilanes, 18 Sep 1891, *Hartman 780* (GH); Majalca, 25 Aug 1945, *Hewitt 44* (GH); San Diego Canyon, Sierra Madre Mts., 16 Sep 1903, *M. E. Jones s.n.* (NY, POM, US); 12 mi w of San Antonio, 20 Sep 1939, *Muller 3382* (GH); Sierra Madre, 21 Jun-29 Jul 1899, *E. W. Nelson 6017* (GH, US); Rosario, e of La Junta, 14-15 Sep 1934, *Pennell 18763* (PH, US); 10 km sw of Minaca, 16-17 Sep 1934, *Pennell 18828* (PH, US); Sierra Madre, 2 Oct 1887, *Pringle 1357* (GH, MO, NY, UC, US); Majalca, 11 Aug 1939, *White 2367* (GH). NUEVO LEON: 15 mi sw of Galeana, 19 May 1934, *Mueller & Mueller 466, 492,* 18 Jul 1934, *Mueller & Mueller 1045* (GH); Las Canaos on Cerro Potosi, 1 Jul 1935, *Mueller 2184 (*CAS, GH, NY); Pablillo, se of Galeana, 26-30 Jun 1934, *Pennell 17008* (PH, US); Cerro Potosi 7 Aug 1938, *Schneider 973* (GH, NY, US); Pablillo, 5 Aug 1936, *Taylor 85* (NY). ZACATECAS: 9 mi nw of Sombrerete, 26 Sep 1948, *Gentry 8484* (GH, US).

The typical form, var. *atrorubens,* is widespread, but tends to be only locally common usually in the low foothills and mountains in the Pinyon-Juniper woodlands of northern Mexico (Fig. 1). It is readily distinguished by the strigose hairs on both surfaces of the leaves, and like most buckwheats, the leaves are often more densely pubescent below than above. The species is closely related to *E. rupestre* S. Stokes which differs mainly in having pubescent flowers, and with this close relationship, I. M. Johnston (Journ. Arn. Arb. 25: 138. 1944) suggested that a more logical nomenclature would be to reduce this species to a variety of *E. atrorubens.* While this change was not made by Johnston, it is still a logical suggestion, but as *E. rupestre* does occupy a geographical area in eastern Chihuahua and does have a distinctive morphological feature, it seems best to wait until detailed field studies are carried out.

As one might suspect from the distribution of var. *atrorubens,* there are some morphological differences in the plants within each area. The Chihuahua plants tends to have stems with varying degrees of swelling or inflation, longer leaf-blades 4-10 cm. long, and a mature, fruiting perianth 3.5-5.0 mm. long that is clasping to the achene. The plants from Nuevo Leon and Coahuila, however, the stems are not inflated and the leaf-blades are shorter, being only 3-5 cm. long, and the mature flowers are only 3.0-3.5 mm. long and do not tend to clasp the achene. While these differences may be noted at present, the amount of material is still meager, and to base a new variety on the limited and variable material now available seems unwise. The Gentry collection from Zacatacus points as the key to this reasoning as it bridges the two populations not only in geographical distribution, but in its morphology. In this population the stems are not inflated, but the leaf-blades are 6-9 cm. long, and the mature flowers are 3-4 mm. long and do not tend to clasp the achene. The geographical separation between the various populations may be real, but until the intermediate mountain ranges which make a

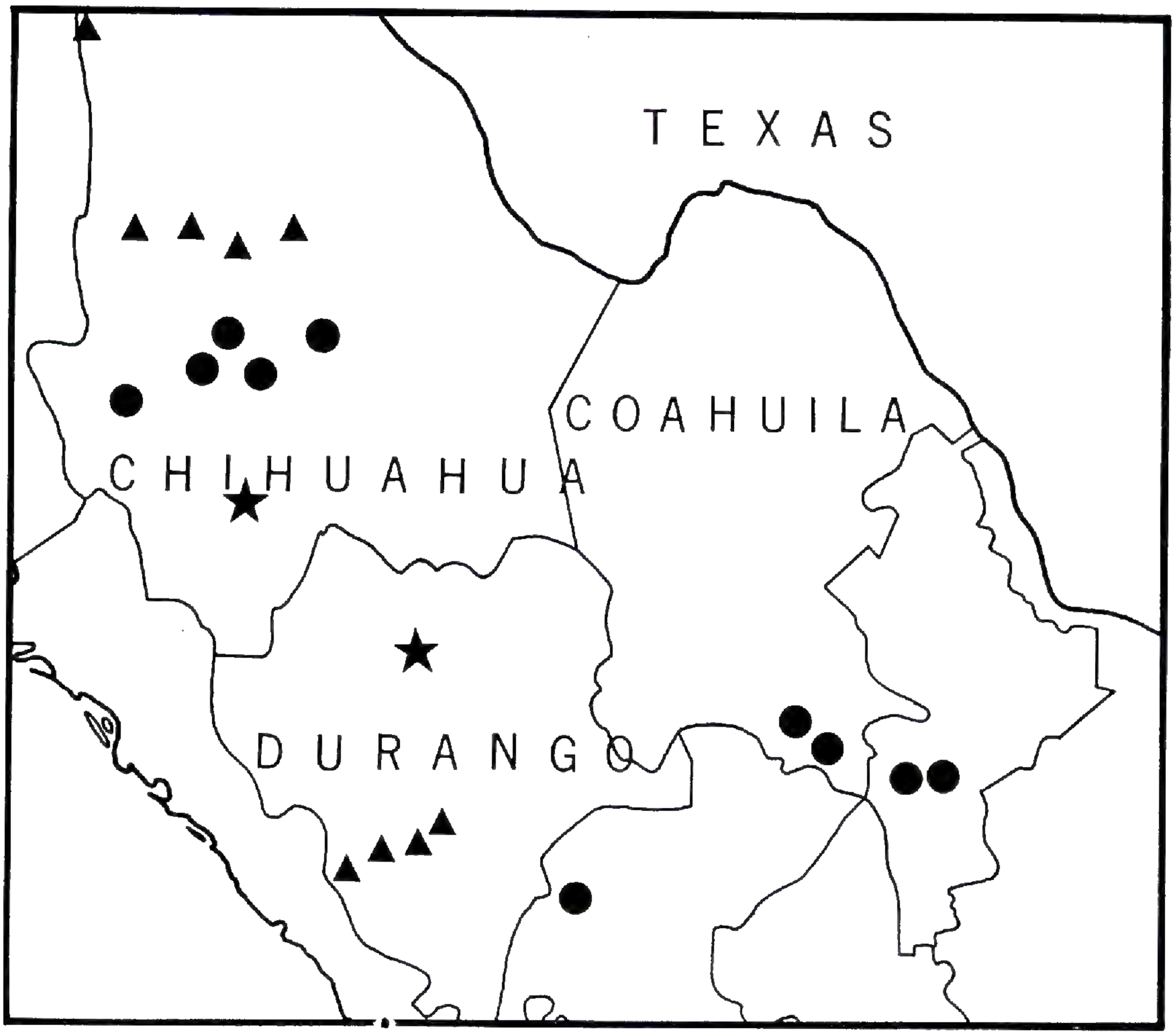

Fig. 1. Distribution of *Eriogonum atrorubens* var. *atrorubens* (circles), var. *pseudociliatum* (triangles), and var. *intonsum* (stars).

gentle arc from Nuevo Leon to Durango, and northward to Chihuahua are thoroughly botanized, one can not really be certain that it is.

ERIOGONUM ATRORUBENS var. **pseudociliatum** Reveal, var. nov.

A var. *atrorubente* differt foliis glabris vel sparsim pilosis supra margine dense ciliato excepto involucris lobis rotundis vel truncatis ad acutis, saepe reflexis.

TYPE: MEXICO: Durango: Otinapa, nw of C. Durango, 25 Jul-5 Aug 1906, *E. J. Palmer 382* US! Isotypes GH, MO, NY.

Representative specimens:

MEXICO: Durango: 63 mi wsw of C. Durango, 28 Jun 1950, *Maysilles 7184*, 9-10 Aug 1952, *Maysilles 7704* (NY, US); Llana Grande, 42 mi wsw of C. Durango, 10 Aug 1955, *Maysilles 8463* (NY); El Salto, 12 Jul 1898, *E. W. Nelson 4552* (GH, US); El Salto, 1 Sep 1936, *Pennell 18554* (NY, PH, US); 34 mi w of C. Durango, 11 Aug 1956, *Waterfall 12649* (GH, US). Chihuahua: Canyon near Santa Clara, 17 Aug 1936, *LeSueur 77* (GH); San Luis Mts., 26 Jul 1892, *Mearns 568* (US), 5 Sep 1893, *Mearns*

2123 (US), 26 Sep 1893, *Mearns 2463* (GH, US); Madera, 27 May-3 Jun 1908, *Palmer 280* (GH, NY, US); Llanura de Babicora, 19 Sep 1934, *Pennell 19008* (NY, PH, US); Colonia Garcia, 23 Sep 1934, *Pennell 19107, 19123* (PH, US); Santa Clara Mts., 22 Jul 1937, *Shreve 7950* (US); Colonia Garcia, 11 Jun 1899, *Townsend & Barber 72* (GH, NY, US).

The var. *pseudociliatum* is so named because it resembles *E. ciliatum* in that the leaf margins and midveins are often densely ciliate with short hairs. This new variety seems to occur at a slightly higher elevation than var. *atrorubens* and in more open sites such as dry meadows, open forests, and exposed mountain slopes.

As found in var. *atrorubens*, the disjunct populations in var. *pseudociliatum* differ in minor morphological features. In this case, those from Chihuahua (except *Palmer 280)* have involucres with acute lobes, whereas the Durango specimens tend to have involucres which are less rigid and the lobes vary from rounded to truncate with the divisions being less in these involucres than those found in the Chihuahua plants. As some overlapping may be seen in some involucres on the same plant specimens, it is enough to prevent any sharp separation, and since the intermediate areas are not well botanized, it seems best not to provide formal nomenclatural designations.

ERIOGONUM ATRORUBENS var. **intonsum** Reveal, var. nov.

A var. *atrorubente* et var. *pseudociliato* differt foliis subtus dense et copiose albo-tomentosis.

TYPE: MEXICO: DURANGO: Inde, Aug 1927, *B. P. Reko 5239* US!

Representative specimens:

MEXICO: CHIHUAHUA: Without locality, 1894, *Lurnholtz 1043* (GH, US); Norogachic, 13-25 Nov 1885, *Palmer JJ* (GH).

The var. *intonsum* (meaning unshaven or bearded) is presently known only from the above specimens. Its distinctive densely white-tomentose leaves quickly set it apart from the rest of *E. atrorubens*, and at first, seemed to represent a distinct species. Subsequent examination of other specimens in *E. atrorubens* soon revealed that the leaf character was the only real, differentiating feature to separate it from var *atrorubens* and var. *pseudociliatum,* and thus this population is assigned to a varietial rank.

SUPRASPECIFIC CLASSIFICATION IN THE SCROPHULARIACEAE: A REVIEW

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The present status of our knowledge of the classification of the Scrophulariaceae, a family of perhaps 250 genera and 5000 species (Thieret, 1959), reflects the general lack of detailed information regarding intra- and extra-familial relationships of many of the families of flowering plants. New and detailed research on the family, using whatever tools are available, and a re-evalution of past research are necessary before a logical taxonomic treatment of the family can be realized. The necessity of such research and such re-evaluation is attested to by the essentially pre-evolutionary, century-old treatment of the family found in the majority of the world's floras. The present paper is meant as a summary of major taxonomic problems presented by the Scrophulariaceae and of especially significant past taxonomic research that has been carried out on the supra-specific level in the family.

My interest in the family was awakened a number of years ago when I began a study of gross internal and external morphology of scrophulariaceous seeds in relation to supra-specific classification of the family. It soon became evident that the taxonomy of this family is in a sorry state indeed, as the following pages will show.

Wettstein (1935) briefly but pointedly characterized the current state of the classification of the Scrophulariaceae when he wrote (p. 897): "Eine natürliche Systematik innerhalb der Familie ist zur Zeit noch nicht erreicht." Indeed, even the limits of the family itself are not agreed upon (compare, for example, the treatments of Wettstein, 1891, and Hallier, 1903).

PREVIOUS CLASSIFICATIONS

The treatment of the Scrophulariaceae which is generally accepted today is that formulated by Wettstein (1891). This, in turn, is based upon the earlier revisions of Bentham and Hooker (1876) and Bentham (1846). The work of Bentham is the latest one to give an account of all the (then-known) psecies o fthe family. This revision, now 121 years old, takes little or no account, of course, of the phylogeny of the Scrophulariaceae. The two subsequent revisions (each on a generic basis) left Bentham's work basically unchanged. Consequently, most treatments of the family (or portions of it) in print today are merely reiterations of a pre-evolutionary, century-old system. Yet, as Pennell (1935) pointed out, the Scrophulariaceae are a family which may be presented on a "remarkably developmental basis."

SIDA 3 (2): 87—106. 1967.

Additions to and some minor revisions of Wettstein's treatment of the Scrophulariaceae have been published in Die *Natürlichen Pflanzenfamilien Nachträge* (Diels, 1908, 1914; Wettstein, 1897). In *Das Pflanzenreich* only the Calceolarieae have appeared (Kränzlin, 1907).

A revision of Wettstein's treatment of the Scrophulariaceae was published in 1903 by Hallier (1903). The most significant features of the revision include the abandonment of characteristics of aestivation as the basis for defining subfamilial divisions; the enlargement of the family to include the Plantaginaceae, Lentibulariaceae (see Mez, 1936), and Orobanchaceae; and the tribal reassignment of many genera. Unfortunately, as Diels (1908) pointed out: "Eine streng analytische Begrenzung der vorgeschlagenen Triben ist nicht gegeben; sie dürfte sich auch schwer schaffen lassen." Hallier's discussion of the systematic position of the Selagineae and *Lagotis* is doubtless the most detailed and critical one given to date. He accepted the inclusion of the Selagineae in the Scrophulariaceae and the removal of *Lagotis* from this tribe to the Digitaleae although in a previous paper (Hallier, 1901) he felt that Baillon and Wettstein were wrong in making these assignments. Of Hallier's revision of the family, Diels (1908) wrote: "Da er, abgesehen von eigenen Anregungen, viele schon früher geäusserte Gedanken zusammenstellt und verwertet, sei sein System als Material für weitere systematische Arbeit an der Familie mitgeteilt."

A provocative primary division of the family, based upon staminal characteristics, was proposed by Van Tieghem (1903). Two types of stamens, differentiated by their anthers, were distinguished, as follows: (a) tétrathéque ("Dorsifixe, pendante, bifide et creusée de quatre sacs polliniques longitudinaux") and (b) dithéque ("basifixe, dressée, entiere et creusée seulement de deux sacs polliniques trasversaux"). According to Van Tieghem, the latter can be derived from the former by atrophy of one half of the anther and displacement of the remaining half which, now median and transverse, becomes bent at the summit of the filament.

The tetrathecal type is found in that division of the family which Van Tieghem called "*Holantherées,*" and the dithecal type in the "*Hémianthérées.*" Representative holantherous genera are *Anthirrhinum, Linaria, Mimulus, Paulownia, Rhinanthus,* and *Melampyrum.* Genera of the hemiantherous division include *Scrophularia, Verbescum, Celsia, Chaenostoma, Manulea, Nemesia,* and *Limosella.* Among the holantherous genera are certain ones *(Harveya, Sopubia, Centranthera, Cycnium, Striga, Zaluzianskia,* and *Buchnera)* in which one-half of the anther is more or less aborted but not displaced. In Van Tieghem's opinion these genera form a link between the Holanthérées and Hémianthérées.

After a study of the characteristics of the nectary of a number of genera of the Personatae (i.e., Scrophulariacae), Bellini (1907) proposed a classification of the family based principally upon these characteristics.

According to him, it is possible to distinguish, with regard to the nectary, four types of Personatae, as follows: (a) nectary is situated upon the hypogynous disc or in a *"glandola antica,"* (b) nectary originates from the aborted fifth stamen, (c) nectary originates from the bases of the filaments of the larger stamens, and (d) nectary is petaloid or lacking.

The Personatae were divided by Bellini into two sub-families, the Scrophulariaceae (not parasitic) and the Rhinanthaceae (parasitic or semi-parasitic). The Rhinanthaceae were further characterized by the development of the nectary in a *"glandola antica,"* a condition unknown in the other subfamily. Otherwise, nectary characteristics were not used in the Rhinanthaceae, the tribes of this subfamily (Gerardieae, Pedicularineae, and Orobancheae) being equivalent to the Gerardieae and Rhinantheae of Wettstein (1891) and the Orobanchaceae.

In the subfamily Scrophulariaceae, tribal divisions were based primarily upon nectary characteristics. Some of the tribes recognized by Bellini (Verbasceae, Hemimerideae, and Calceolarieae) are equivalent to these tribes as delimited by Wettstein. On the other hand, Wettstein's Antirrhineae were divided into the Linarieae (with calcarate *"nettaroconca")* and Antirrhineae (with saccate *"nettaroconca")*. In contrast to these homogeneous tribes, others, as delimited by Bellini, are heterogeneous groups of genera, e.g., the Mimuleae (including *Mimulus, Paulownia,* and *Maurandya)* and the Digitaleae (including *Digitalis, Scrophularia, Ghiesbreghtia (= Eremogeton),* and *Lindernia)*. These tribes, though possessing nectarial homogeneity, are composed of genera which, by virtue of a host of other characteristics, are discordant in such close alliance.

The genera *Collinsia* and *Tonella* were placed by Bellini in the tribe Collinsieae (here first proposed), a taxon characterized by the origin of the nectary from the aborted fifth stamen. This recognition of the distinctness of the Collinsieae is one of of the salient features of Bellini's classification. Unfortunately, it was overlooked by Pennell (1935) who "proposed" the identical taxon Collinsieae based, however, on characteristics other than those of the nectary.

The Orobanchaceae have been included in the Scrophulariaceae not only by Bellini but also by Hallier (1903). It has long been recognized that certain members of both taxa are essentially alike in habitat, habit, flower structure, and seed-coat structure (Tiagi, 1952). Both are characterized by the formation of endosperm haustoria (Glisic, 1929). According to Boeshore (1920), the two taxa are alike logically and biologically and thus should be treated in "continuous descending series from the highest to the most degraded genera." (See also Linsbauer and Ziegenspeck, 1943).

The conspectus of the tribes and genera of the Scrophulariaceae published by Rouy (1909) is essentially a combination of various features

of the Bentham, Bentham and Hooker, and Wettstein treatments of the family.

Some attempts at a reclassification of certain portions of the family on a phylogenetic basis were made by Pennell (1935). Pennell's work in the Scrophulariaceae, however, was confined almost entirely to the New World (and North America in particular). Thus, his reclassification was based upon his extensive knowledge of the New World representatives of the family and, as a result, does not take into consideration the numerous Old World representatives. Treatments of the Scrophulariaceae based upon Pennell's work have appeared, of course, in his papers of a floristic nature (1919, 1920, 1921, 1923, 1935, 1941) and in at least two floras, both of them of areas in North America (Abrams, 1951; Gleason, 1952). Pennell's contributions to a phylogenetic classification of the Scrophulariaceae, though of inestimable value, must be regarded as provisional until a world-wide study of the family is made with a view to reclassification.

SUBFAMILIAL DIVISIONS

In Wettstein's (1891) treatment of the Scrophulariaceae, the primary divisions of the family are the Pseudosolaneae, Antirrhinoideae, and Rhinanthoideae. These divisions may be presumed to be subfamilies although they were not designated as such by Wettstein. The Pseudosolaneae have the initial position, apparently to emphasize their supposed affinities with the Solanaceae based upon the nearly actinomorphic corolla, alternate phyllotaxy, and presence of the full complement of five stamens in *Verbascum*. *Verbascum* has long been regarded as the logical connecting link with the Solanaceae and has been considered to be "on the road to acquiring zygomorphism, but to which [it] has [not] yet fully attained" (Henslow, 1893). According to Wettstein (1891), "Am nächsten stehen die Scrophulariaceen den Solanaceen, zu denen der Übergang einerseits durch die Verbasceae, andererseits durch die Salpiglossideae vermittelt wird." Indeed, the Salpiglossideae have even been included in the Scrophulariaceae, as in Bentham's treatment of the family (Bentham, 1846).

Apparently the first person to cast doubt upon the presumed primitiveness (and thus upon the presumed solanaceous affinities) of *Verbascum* was Robertson (1891) who supposed "the prototype of *Verbascum* to have been a bilabiate flower with didynamous stamens, because the type of the order is didynamous and because the two genera with which *Verbascum* form the tribe Verbasceae have only four stamens."

Impressive evidence to refute the presumed affinities of *Verbascum* with the zygomorphic Solanaceae was presented by Robyns (1931) who disclaimed the alliance because the zygomorphy characteristic of *Verbascum* is of the type characteristic of other members of the Scrophulariaceae but not of the zygomorphic Solanaceae. Robyns emphasized most strongly the oblique alignment of the carpels in the Solanaceae as

contrasted with their median alignment in the Scrophulariaceae and the loss or reduction of one of the anterior stamens in many Salpiglossideae as contrasted with the loss or reduction of the posterior stamen in most Scrophulariaceae.

In aestivation the corolla is plicate in the Solanaceae but imbricate in the Scrophulariaceae. Anatomical evidence against the alliance is furnished by the bicollateral vascular bundles of the Solanaceae, whereas those of the Scrophulariaceae are collateral. The *Verbascum* type of seed, characterized by the presence of longitudinal and transverse endosperm ridges and local proliferation of cells in the inner layers of the testa, apparently is not found in the Solanaceae.

Thus, the conclusion may be reached that the long accepted affinity of the Verbasceae with the Solanaceae is apparent rather than real. However, the position of the Verbasceae within the Scrophulariaceae remains an open question, i.e., is the tribe primitive or derived.

Robertson's (1891) conclusion, that the prototype of the flower of *Verbascum* was a bilabiate flower with didynamous stamens, is identical with that reached by Pennell (1935) who regarded the nearly actinomorphic corolla, the frequent presence of five stamens, and the alternate leaves as derived rather than primitive characteristics in the Scrophulariaceae. Further evidence that the Verbasceae are not primitive members of the family may be seen in the united stigmas and the relatively complex seeds of this taxon.

Since the subfamily Pseudosolaneae was based on the supposed affinities of its members with the Solanaceae, and since these affinities have been shown to be unreal, this subfamily should be dissolved (Pennell, 1935). The Scrophulariaceae, then, are divided into two subfamilies, the Antirrhinoideae and the Rhinanthoideae. These differ in the external position of the posterior corolla lobes in aestivation in the former as contrasted with the external position of the anterior corolla lobes in the latter. The Verbasceae, Leucophylleae, and Aptosimeae, the three tribes included in Wettstein's Pseudosolaneae, must now be placed in the Antirrhinoideae.

The relative position of the corolla lobes in aestivation as the basis for dividing the Scrophulariaceae into two subfamilies seems to be a slight difference upon which to found so fundamental a distinction. However, as Pennell (1935) wrote, "it appears to be one of great racial value." Nevertheless, further investigation may disclose other criteria upon which to base the sub-familial division of the Scrophulariaceae. Schmid (1906) questioned the inclusion of *Digitalis* in the same subfamily as the Gerardieae (=Buchnereae) and Rhinantheae (=Euphrasieae) because this genus, in its embryology, has little in common with the two latter taxa, which apparently are embryologically quite similar. The Digitaleae are not root parasites, another point of contrast with the usually parasitic Gerardieae and Rhinantheae. Bellini (1907) used para-

sitism versus non-parasitism as the criterion for the division of the Scrophulariaceae into the two subfamilies. Hallier (1903) did not consider aestivation characteristics as a good basis for the subfamilial division, for he wrote: "Es scheint mir daher natürlicher zu sein, die alte Benthamsche, auf die Art der Knospendeckung der Krone gegründete Eintheilung der Familie ganz fallen zu lassen. . . ." Hartl (1957) reported that the anterior lobes of the corolla of *Lindenbergia,* a genus of the Antirrhinoideae, are external in the bud, which lends credence to Diels' (1897) assertion that the relative position of the corolla lobes in the bud is, in certain cases, a feature of little importance in establishing relationships.

Since the Verbasceae have been shown to possess characteristics which, in the Scrophulariaceae, are derived rather than primitive, this tribe may no longer occupy the initial position in the family. Search for the initial tribe should take place among the Antirrhinoideae since the Rhinanthoideae, on the basis of specialized habits of parasitism and of elaborate zygomorphy, appear to be the derived group.

A survey of the seeds of the Antirrhinoideae reveals that the most simple seeds (structurally) are found almost exclusively in the Gratioleae. Here, then, is a suggestion that this tribe may represent the primitive type of Scrophulariaceae. Additional investigation of the tribe brings forth other evidence which supports this suggestion: usually distinct stigmas, usually septicidal dehiscence of the capsule, usually distinct sepals, the racemose inflorescence, and the opposite phyllotaxy. It seems, then, logical to assign the Gratioleae to the initial position in the family, as has been done by Pennell (1935).

THE TRIBES

The following discussion of certain tribes of the Scrophulariaceae deals with these taxa as delimited by Wettstein (1891) and as usually recognized at present.

VERBASCEAE

The Verbasceae (sensu Wettstein, 1891) comprise five genera: *Verbascum, Celsia Staurophragma, Leucophyllum,* and *Ghiesbreghtia (=Eremogeton).* Presumably a more logical treatment of this taxon would be its division into two tribes, the Verbasceae (sensu Bentham, 1846) and the Leucophylleae (sensu Bentham and Hooker, 1876). That these two taxa are probably closely related is shown by their alternate leaves and, more especially, by their branched trichomes, a feature restricted, in the Scrophulariaceae, to these taxa. However, their many points of difference surely entitle them to tribal (rather than subtribal) rank. The Verbasceae are Old World plants; the Leucophylleae are New World plants. In the Verbasceae the flowers are disposed in simple or compound racemes or spikes and the corolla is rotate; in the Leucophylleae the flowers are axillary and the corolla is campanulate. The anther sacs are

wholly confluent in Verbasceae but distinct in Leucophylleae. At least the posterior filaments in the Verbasceae are villous, whereas all filaments in the Leucophylleae are glabrous. In addition to the above characteristics must be mentioned the seeds of *Verbascum* and *Celsia* (with their characteristic ridges attributable to endosperm proliferation) as contrasted with the scalariform-reticulate seeds of *Eremogeton* and *Leucophyllum*. Indeed, judging from the seeds, *Verbascum* and *Celsia* may be less closely related to the Leucophylleae than to *Scrophularia* and *Russelia*.

CHELONEAE

The Cheloneae, as presented by Bentham (1846) and enlarged by Wettstein (1891), are an assemblage of genera whose principal common characteristic is the cymose disposition of the flowers. As the result of the use of this characteristic as the principal one defining the Cheloneae, including herein all Scrophulariaceae (except Calceolarieae) possessing such inflorescences, this tribe possesses a heterogeneity equalled in the family only by the Digitaleae sensu Wettstein.

An examination of the genera included in the Cheloneae by Wettstein reveals that many of them possess features which show them to be closely related to taxa other than the Cheloneae.

To the Bignoniaceae were transferred *Synapsis* by Urban (1926), *Paulownia* by Campbell (1930), and *Wightia* by Hallier (1903). Hallier transferred *Brookea* and *Uroskinnera* to the Gesneriaceae, the transfer of the latter genus being perhaps in error (Schultes, 1941).

Leucocarpus, *Berendtiella* (=*Berendtia* A. Gray), and *Hemichaena*, as is evidenced by their distinct, plate-like stigmas, their campanulate, 5-ribbed, 5-toothed calyces, and their loculicidal capsules (in the last two genera), are near allies of *Mimulus* and thus must be transferred to the Gratioleae (Pennell, 1935). *Leucocarpus*, even though it possesses a baccate fruit, is obviously closely related to *Hemichaena* as is evidenced not only by its distinctive stigmas and calyx but also by its reticulate seeds with intra-reticular lines of a type apparently found nowhere else in the Scrophulariaceae except in these two genera.

Because of distinctive nectary characteristics of *Collinsia* and the closely related *Tonella*, Bellini (1907) proposed the tribe Collinsieae to include these two genera. Apparently overlooking Bellini's work, Pennell (1935) also proposed a tribe Collinsieae for *Collinsia* and *Tonella*. In addition to the characteristics of the nectary and those mentioned by Pennell (greatly modified "papilionaceous" corollas, loculicidal capsules, and annual duration), the distinctive large seeds, few in number per capsule, and the spatulate embryos provide ample justification for the setting apart of these genera in the Collinsieae.

The genus *Russelia*, recently monographed by Carlson (1957), appears to be somewhat enigmatic in its relationships. The outstanding characteristic of the genus is the presence of densely packed long hairs with-

in the loculicidal capsule. By virtue of this characteristic, which occurs nowhere else in the Scrophulariaceae, *Russelia* seems to be a somewhat isolated genus and may perhaps best be treated as the sole member of the tribe Russelieae. The close resemblance of the seeds of *Russelia* and *Scrophularia* to those of *Verbascum* and *Celsia* suggests a closer relationship between these two groups of genera than is indicated by current classifications.

After the above mentioned genera have been transferred from the Cheloneae sensu Wettstein, the remaining genera form a slightly less heterogeneous taxon but one, nevertheless, which is still discordant. For example, it contains both baccate and capsular fruits, both loculicidal and septicidal capsules, and some of its genera are characterized by the presence of staminodes while others show no trace of the fifth stamen.

Certain problems appear uppermost in an attempt at redefining the Cheloneae; several of these will be briefly discussed here.

What is the taxonomic significance of the baccate fruit of *Dermatocalyx*, *Halleria*, and *Teedia*? To include both baccate and capsular fruits within the same tribe seems somewhat inconsistent. However, both Bureau (1863), in a study of *Monttea*, and Crété (1952), in an embryological study of *Teedia lucida*, recommended that not too much taxonomic importance should be attributed to fruit type in the Scrophulariaceae. An obvious example of the misplacing of a genus as the result of emphasis of fruit type is seen in *Leucocarpus*, formerly included in the Cheloneae among the other genera with baccate fruits, but which must pass to the Gratioleae and stand near *Mimulus*.

What is the position of those genera of the Cheloneae which are characterized by loculicidal dehiscence of the capsule? Pennell (1935) apparently considered them to be closely related to genera of another tribe. Unfortunately, he was no more specific than this.

Can the presence or absence of staminodes be used as an important characteristic in the redefinition of the Cheloneae? As this tribe is currently defined, it includes genera which possess staminodes and those which do not. Polak (1900) showed that most Cheloneae possess one or more staminodes and suggested an investigation of the systematic position of those genera which do not. It is important to realize in connection with the evaluation of the importance, in the Cheloneae, of the presence or absence of staminodes that at least one genus of this tribe, *Scrophularia*, most of whose species have staminodes, contains several species in which the staminode is completely lacking (Stiefelhagen, 1910). This is in contrast to those genera, e.g., *Penstemon* and *Chelone*, which are characterized by the constant presence of staminodes.

The systematic position of *Scrophularia* needs further investigation. The seeds of this genus are, in their gross external and internal structure, almost identical with those of *Verbascum and Celsia*. The microscopic structure of the testae of *Scrophularia* and *Verbascum* is "ganz

analog" (Bachmann, 1882). Schmid (1906) asserted that *Scrophularia* and *Verbascum* are obviously more closely related to each other than current systems indicate. He found the development of the endosperm and haustoria and the behavior of the tapetal layer to be very similar in these two genera. Hartl (1959) discussed structural resemblances among the seeds of *Scrophularia, Verbascum, Celsia,* and *Sutera* and designated the seeds of these taxa as the "Scrophularia-type." He concluded that "Gattungen mit Samen vom Scrophularia-Typ scheinen untereinander taxonomisch verwandt zu sein." Other points of resemblance of *Scrophularia* to *Verbascum* and *Celsia* are its sometimes hairy filaments, its reniform anthers with wholly confluent sacs, and its septicidal, many-seeded capsule. The inflorescence of certain species of *Scrophularia* (e.g., *S. vernalis)* bears a great resemblance to that of certain *Verbascum* species (e.g., *V. lychnitis). Scrophularia laciniata, S. canina, S. hoopii,* and other species of the genus have laciniate leaves, a characteristic, not at all common in the Scrophulariaceae, possessed also by certain *Celsia* species (e.g., *C. orientalis).* It is interesting that in the *Genera Plantarum* of Endlicher (1836-40) the genus *Scrophularia* is included with *Verbascum* in the Verbasceae.

What is the taxonomic significance of the distinct stigmas of *Dermatocalyx* and *Uroskinnera?* Other genera of the Cheloneae sensu Wettstein possessing this characteristic must, as shown previously, pass to the Gratioleae. Study of *Dermatocalyx* and *Uroskinnera* may show that they, too, must be transferred from the Cheloneae. Unfortunately, Schultes (1941), in his synopsis of *Uroskinnera,* failed to consider the systematic position of the genus.

The systematic position of *Paulownia* tomentosa is as yet undetermined. This species, named *Bignonia tomentosa* in 1784, was renamed *Paulownia tomentosa* by Siebold and Zuccarini in 1835 *(fide* Campbell, 1930). Endlicher (1836-40) transferred it from the Bignoniaceae to the Scrophulariaceae because of the presence of endosperm in its seeds. This character, according to Campbell (1930), is the only one by which it differs from typical members of the Bignoniaceae. In the mature seed are found two or three layers of endosperm cells (Millsaps, 1936). *Paulownia* is included in the Scrophulariaceae in *Die Natürlichen Pflanzenfamilien* (Wettstein, 1891). However, the genus was referred to the Bignoniaceae by Hallier (1903) and, later, by Campbell (1930) and Li (1947). Pennell apparently was in agreement with this transfer *(fide* Britton, 1920). Nevertheless, in the eighth edition of *Gray's Manual of Botany* (Fernald, 1950) and the *New Britton and Brown Illustrated Flora of the Northeastern United States and Adjacent Canada* (Gleason, 1952), *Paulownia* is found among the Scrophulariaceae. Of the genus Gleason (Gleason, 1952) wrote: "The structure of the placenta and the capsule and the presence of endosperm confirm its presence in the Scrophulariaceae." (Placental differences between the Scrophulariaceae and the

Bignoniaceae were pointed out by Bureau, 1863.) Steenis (1949) advocated the inclusion of *Paulownia* (and *Wightia)* in the Scrophulariaceae.

A solution to the problem of the position of *Paulownia* will never be reached by transferring the genus back and forth between the Bignoniaceae and the Scrophulariaceae. What is needed is a detailed study of the seeds of the Bignoniaceae to determine if the absence of endosperm is constant in this family. Following this, a comparative study of the placentae of the Scrophulariaceae and the Bignoniaceae would reveal if the differences reported by Bureau are constant. Then, and only then, may *Paulownia* be placed with certainty.

GRATIOLEAE

As outlined by Bentham (1846) as Gratioleae, subtribe Eugratioleae, and as summarized as Gratioleae by Wettstein (1891), this taxon comprises a large assemblage of obviously related genera (with the exceptions noted below). The tribe is characterized by a uniformity of seed types that is found in no other tribe of the Scrophulariaceae. Most of the genera of the Gratioleae whose seeds I have studied are characterized by either scalariform-reticulate (*Bacopa* type) or sulcate scalariform-reticulate, small (less than 0.7 mm in length), numerous seeds. However, pitted seeds occur in *Lindernia* and *Torenia,* and furrowed seeds in *Schistophragma* and *Stemodia.* (See Thieret, 1954, for illustrations of several seed types of the Gratioleae.) The Gratioleae are further distinguished by usually distinct stigmas, a feature found only rarely in the rest of the Antirrhinoideae.

To the genera included by Wettstein in the Gratioleae must be added *Leucocarpus, Hemichaena,* and *Berendtia* from the Cheloneae *sensu* Wettstein. These genera, as previously discussed, possess a combination of characters which shows them to be allies of *Mimulus. Scoparia* and *Capraria,* placed in the Digitaleae by Bentham and retained there by Wettstein although the exterior posterior corolla lobes of these genera exclude them from the Rhinanthoideae, must be transferred to the Gratioleae as evidenced by their frequently four-angled stems, their delicate, relatively long pedicels, their axillary flowers, and especially by their possession of glands on the calyx, pedicel, etc. (for a discussion of these glands see Solereder, 1899) (Pennell, 1935). The small, globose, 4-valved capsules of *Scoparia* and *Capraria* resemble those of *Conobea* Aubl. and many other Gratioleae. The seeds of these two genera are of the *Bacopa* type characteristic of many Gratioleae.

Two genera, *Monttea* and *Melosperma,* included in the Gratioleae by Wettstein, are surely out of place in this tribe. In the case of *Melosperma,* its few large seeds and spatulate embryos seem to exclude it from a tribe characterized otherwise by numerous small seeds and terete embryos. According to Reiche (1911), the bilocular ovary of *Melosperma andicola* (the only known species) contains many ovules in each locule. At maturity, however, the capsule contains only a few

(6-8) seeds with but little endosperm. The stigmas of *Melosperma* are united, another indication that it should be removed from the Gratioleae.

In the case of *Monttea,* Reiche (1911) described the ovary as containing many ovules but the capsule as containing only one or two large seeds. The seeds apparently are without endosperm (Bureau, 1863; Weberbauer, 1901). As in *Melosperma,* the stigmas are united.

The systematic position of *Melosperma* is difficult to ascertain. Certainly it is out of place in any of the tribes of the Antirrhinoideae as now defined (including the extremely ill-defined Cheloneae *sensu* Wettstein). *Monttea* is also difficult to place in any of the existing tribes of the Scrophulariaceae. Bureau (1863) suggested that this genus (and *Oxycladus,* included by Wettstein in *Monttea*) be segregated as a new tribe.

After a study of the aestivation of the corolla, the stamens, and other characteristics of a number of Indian species of *Lindenbergia* and related genera, Brühl (1920; abstract in Dudgeon, 1920) assigned the genus to the Rhinanthoideae either near *Euphrasia* or near the head of the sub-family since it appeared to him to be a connecting link with the Gratioleae of the Antirrhinoideae with which it has usually been placed. *Lindenbergia* has recently been studied by Hartl (1957), who referred it to the Gratioleae.

The genus *Conobea (sensu* Wettstein, 1891) is manifestly a heterogeneous assemblange of plants. This fact is revealed especially by an examination of the seeds of the genus. The seeds of section *Sphaerotheca* are scalariform-reticulate; those of the three species of section *Leucospora* are scalariform-reticulate, sulcate scalariform-reticulate, or spirally furrowed, respectively; and those of section *Schistophragma* are spirally furrowed. A natural treatment of this aggregate would give generic status to each of these sections after revising each of them.

The revised section *Sphaerotheca (Conobea* Aubl.) would contain the three species therein included by Wettstein and, in addition, *Conobea vandellioides* Benth. from section *Leucospora.* From the latter section *C. intermedia* must be transferred to section *Schistophragma,* thus leaving section *Leucospora* with but one species, *C. multifida* (Michx.) Benth. Section *Schistophragma,* then, would contain *C. intermedia* Gray in addition to *C. pusilla* Benth. Each of these sections must now be raised to generic level as *Conobea* Aubl., *Leucospora* Nutt., and *Schistophragma* Benth.

Leucospora multifida (Michx.) Nutt., originally *Capraria multifida* Michx., was made the type of the new genus *Leucospora* by Nuttall. In Bentham's revision of 1846 it was included as a member of *Conobea* Aubl. of lowland northern South America and has since been usually treated as such. Actually, it has little in common with this genus of tropical America.

Schistophragma Benth. was based on *S. pusilla* Benth. ranging from

northern Colombia northward to Mexico. Later, *S. pusilla* was included in *Conobea* Aubl. by Bentham and Hooker (1876), a transfer which probably would not have been made had the authors taken into account the morphology of the seeds. *Conobea intermedia*, of northwestern Mexico and the adjacent parts of New Mexico and Arizona, was described by Gray. This species must now be transferred to *Schistophragma*, a distinctive genus characterized principally by spirally furrowed seeds, pinnatifid leaves, and elongate to linear capsules.

The genera *Conobea*, *Schistophragma*, and *Leucospora* may be distinguished as follows;

Seeds scalariform-reticulate, in more than one row within each valve of the capsule; capsule depressed globose; leaves serrate, glandular-punctate; plant glabrous; stem quadrangular; pedicels bibracteolate; posterior lip of corolla shorter than anterior lip; connective not enlarged, anther cells proximate . . . . . *Conobea*

Seeds sulcate scalariform-reticulate, in more than one row within each valve of the capsule; capsule ovoid; leaves pinnatifid, not punctate; plant pubescent; stem terete; pedicels not bibracteolate; corolla lips of equal length; connective slightly enlarged, holding the cells of the anther somewhat apart . . . . . *Leucospora*

Seeds spirally furrowed, in one row within each valve of the capsule; capsule elongate to linear; leaves pinnatifid, not punctate; plant pubescent; stem quadrangular; pedicels bibracteolate; corolla lips of equal length; connective slightly enlarged, holding the anther cells somewhat apart . . . . . *Schistophragma*

These three genera are certainly not so closely related as their inclusion as sections in *Conobea (sensu* Wettstein) would indicate. *Conobea* Aubl. is apparently a relatively unmodified member of the Gratioleae by virtue of its scalariform-reticulate seeds, globose capsules, and serrate leaves. *Leucospora* seems somewhat isolated from other Gratioleae, its seeds separating it from *Schistophragma* with which it agrees in habit and pinnatifid leaves, and its stamens with parallel anthers separating it from *Micranthemum*, *Lindernia*, *Hemianthus*, and *Limosella* with which it agrees in seeds. The relationships of *Schistophragma*, on the other hand, appear to be easier to establish. The distinctive markings of its seeds, which Pennell (1940) called apparently "unique in the Scrophulariaceae," do not, however, occur only in this genus but also in *Stemodia*. Another point of agreement between these two genera is seen in the slightly enlarged connective holding apart the cells of the anthers of both genera. So close are *Schistophragma* and *Stemodia* that a suffrutescent form of *Schistophragma intermedia* from Lower California was described by Brandegee as *Stemodia polystachya*. This name should probably be reduced to synonymy under *Schistophragma intermedia*, although further study may indicate that the lower California suffrutescent form of the species be given sub-specific or even specific rank.

The genus *Lindernia* is characterized by two types of seeds: (a) sulcate scalariform-reticulate (e.g., in *L. dubia* and *L. anagallidea)*, and (b) pitted (in two species, *L. crustacea* and *L. diffusa)*. Pitted seeds of similar aspect occur in at least those species of *Torenia* examined by me. Seeds of this type, in the Scrophulariaceae, I have seen only in *Torenia* and the above-mentioned species of *Lindernia,* suggesting that a study of these genera with a view to their revision is necssary. This suggestion is confirmed by a review of the history of the widespread plant currently known as *Lindernia crustacea.* Originally described by Linnaeus as *Capraria crustacea,* it was transferred by Chamisso and Schlechtendal to *Torenia.* Finally, it was placed in *Lindernia* by Mueller (*fide* Pennell, 1920). In his "Scrophulariaceae of Colombia" Pennell (1920) advocated the alliance of this species with *Torenia;* 15 years later, however, he treated it as *Lindernia crustacea* (Pennell, 1935). Here, then, is a plant which has been placed both in *Torenia* and *Lindernia,* suggesting, of course, that it combines the characteristics of both genera. It has the pitted seeds characteristic of apparently only one other species of *Lindernia,* but, in contrast, characteristic of a number of species of *Torenia.* It seems quite possible that a detailed study of these genera will indicate that they should be combined. That they are closely related has long been recognized. In at least one other instance in the Gratioleae, the union of groups previously given generic rank has resulted in the formation of a larger but more natural genus. This case is that of *Lindernia* itself. As now recognized (Mukerjee, 1945; Pennell, 1935), *Lindernia* has been enlarged to embrace *Vandellia, Ilysanthes,* and *Bonnaya.*

SELAGINEAE

The tribe Selagineae consists of about 120 species of herbaceous or shrubby plants of healthlike appearance, principally South African but occuring also in Madagascar and on the mountains of tropical Africa (Rendle, 1925).

The Selagineae, long given family status, were first reduced to tribal rank in the Scrophulariaceae by Baillon (1888), whose treatment of them was accepted by Wettstein (1891) and Hallier (1903). Previous to (and even since) Baillon's work, the Selagineae were (and have been) regarded as a distinct family related either to the Myoporaceae and Verbenaceae (Bentham and Hooker, 1876; Choisy, 1848; Endlicher, 1836-40; Hutchinson, 1926; Rolfe, 1883; Van Tieghem, 1891) or to the Scrophulariaceae (Marloth, 1932; Rendle, 1925).

In the majority of these interpretations the Selaginaceae comprise those genera included in the Selagineae (*sensu* Wettstein, 1891) and, in addition, the genus *Lagotis.* Van Tieghem (1891), however, enlarged the Selaginaceae to include the Myoporaceae and Globulariaceae, thus distinguishing three tribes as follows: Myoporeae ("Etamines á quatre sacs, carpelles fermés"), Selagineae ("Etamines á deux sacs, carpelles

fermés"), and Globularieae ("Etamines á quatre sacs, carpelles ouverts").

The plan of structure of the flowers of the Selagineae *(sensu* Wettstein) is that of the Scrophulariaceae. The basis for their uncertain systematic position is found in the structure of the ovary, which contains in each cell a single pendulous ovule, and of the fruit, a schizocarp which consists of two equal or unequal cocci which become free when mature, each of these containing a single seed. Choisy (1848) regarded the Selaginaceae as being related to the Verbenaceae and the majority of labiates on the basis of the structure of the fruit. He noted, however, that this family differs from these taxa by the presence of endosperm (according to Martin, 1946, certain verbenaceous and labiate genera possess an endosperm), by the position of the embryo in the seed (the radicle is superior in Selaginaceae but inferior in Verbenaceae), by the frequently alternate leaves, and by other minor characters.

The most critical discussion of the systematic position of the Selagineae is that given by Hallier (1903) who, after a study of numerous specimens of members of this taxon, was in complete agreement with its reduction, by Baillon and Wettstein, to tribal rank in the Scrophulariaceae.

The presence of a schizocarp need not exclude the Selagineae from the Scrophulariaceae for this type of fruit is also present in the genus *Lagotis,* belonging to the Veroniceae (Hallier, 1903; Pennell, 1933; Thieret, 1955). After studying the anatomy of the fruits of the Scrophulariaceae, Weberbauer (1901) commented on the Selagineae: "Ich [konnte] mich nicht entschliessen, die Gruppe der Selagineae, welche unter den Scrophulariaceen ziemlich scharf abgesondert besteht, und der früher der systematische Rang einer Familie zuerzannt wurde, auf Grund der Frucht-Anatomie zu zersplittern."

ANTIRRHINEAE

In Wettstein's revision of the Scrophulariaceae the Antirrhineae are placed centrally in the Antirrhinoideae. This tribe, however, surely is one of the most highly evolved of all Scrophulariaceae as is evidenced by the elaborate and specialized seeds, the extreme zygomorphy of the corolla, the greatly modified dehiscence of the capsule, and the alternate or scattered phyllotaxy. The Antirrhineae, thus, seem more naturally placed as the most advanced tribe in the antirrhinoid division of the family.

The tribe, as defined by Wettstein, includes three genera with septicidal capsules. These taxa, *Nemesia, Diclis,* and *Colpias,* were transferred to the Hemimerideae by Diels (1897). Rothmaler (1943), whose synopsis of the Antirrhineae is the only one since that of Wettstein, also referred these genera to the Hemimerideae. Thus, with the removal of *Nemesia, Diclis,* and *Colpias,* the Antirrhineae become a tribe uniformly characterized by loculicidal transverse or poroid ruptures of the capsule.

DIGITALEAE

The tribe Digitaleae as presented by Wettstein (1891) is probably the least coherent in his revision of the Scrophulariaceae. Referring to Wettstein's key to the tribes of the family, one may note that all members of the Digitaleae, as there indicated, should have at least two characteristics in common: the upper corolla lobes internal in the bud, and plants not parasitic. All the genera in Wettstein's Digitaleae (except *Scoparia* and *Capraria*, since transferred to the Gratioleae) apparently possess these features; however, the following key to the genera *Digitalis* and *Veronica* will emphasize the heterogeneity, in other features, found in the Digitaleae.

stigmas distinct; anther cells divaricate; capsule woody, septicidal . . . . . *Digitalis*

stigmas united; anther cells parallel; capsule hardly or not woody, loculicidal . . . . . *Veronica*

Thus, as in the case of Cheloneae sensu Wettstein, the Digitaleae sensu Wettstein comprise genera which should not be included in the same tribe if that tribe is to be homogeneous. It is unfortunate that Wettstein did not follow Bentham (1846) who placed *Veronica* and *Digitalis* in the separate tribes Veroniceae and Digitaleae. The splitting of Wettstein's Digitaleae into at least two tribes has been regarded as necessary by Rouy (1909) and Pennell (1921).

Further study is necessary before final conclusions may be reached in regard to the dismemberment of the Digitaleae. However, discussion of the steps already taken to revise the Digitaleae seem pertinent here.

According to Pennell (1935), most of the genera in Wettstein's Digitaleae pertain to the Veroniceae "as now understood." Pennell, however, failed to clarify what seems to be an important point, i.e., the current understanding of the Veroniceae. In his discussion of the Digitaleae he stated that this tribe is a small one, comprising only the genus *Digitalis* and perhaps *Rehmannia*. (Many years before, *Rehmannia* had been broken up into three genera by Solereder, 1909, and two of these, including *Rehmannia* proper, had been transferred to the Gesneriaceae; even earlier, Hallier, 1903, suggested that *Rehmannia* is gesneriaceous; in contrast, see Burtt, 1954, for the suggestion that *Rehmannia* has, to the student of Gesneriaceae an "alien look.")

Certain genera of the Digitaleae sensu Wettstein (and even sensu Bentham) belong clearly to the Veroniceae emend., as pointed out by Pennell (1921, 1933, 1937). These are *Veronica, Veronicastrum, Hebe, Picrorhiza, Wulfenia, Synthyris, Besseya,* and *Aragoa*. Pennell (1933) included in the Veroniceae emend. also the genus *Lagotis*, a taxon whose affinities, as will be shown later, have been much discussed. To these genera I would follow Van Tieghem (1891) and add *Globularia*, which has traditionally been placed in the Globulariaceae (Thieret, 1955).

In addition to those listed above, two additional genera with New World representatives are included in Wettstein's Digitaleae. The af-

finities of the genus *Sibthorpia,* recently monographed by Hedberg (1955), are presently not clear. Pennell, in limiting the Digitaleae emend. to *Digitalis* and perhaps *Rehmannia,* apparently excluded *Sibthorpia* from this tribe. On the other hand, *Sibthorpia* was implicitly excluded from the Veroniceae emend. by Pennell (1937) when he referred to *Aragoa* as the only genus of this alliance native to tropical America (*Sibthorpia* is native in tropical America as well as in Africa and Eurasia, according to Hedberg, 1955).

The genus *Ourisia,* with members in South America, Australia, and New Zealand, combines the united stigmas of the Veroniceae emend. with the divaricate anther cells of the Digitaleae emend. Only future study can decide the affinities of *Ourisia,* although Hallier (1903) advocated transferring certain species of this genus to the Gesneriaceae.

Floral and vegetative features of the genus *Lagotis (Gymnandra),* comprising 13 species (Li, 1954) ranging from the highlands of Asia Minor through central Asia to subarctic Alaska and the Yukon, prove it an ally of *Picrorhiza, Wulfenia, Synthyris, Besseya,* and *Globularia* (Hallier, 1903; Pennell, 1933; Thieret, 1955). Its fruit, however, is schizocarpic, being sometimes separable into two indehiscent, one-seeded cocci. (According to Pennell, the fruit is a capsule. It is not.) Thus, the fruit of *Lagotis* is essentially similar in type to that of the Selagineae; in cellular structure, however, it appears to be similar to the fruit of *Aptosimum* and *Monttea* rather than that of the Selagineae (Weberbauer, 1901).

The genus *Lagotis* was founded by Gaertner in 1770 on a plant from Kamchatka described by Gmelin in 1768 as a *Veronica.* Until 1846 the genus was treated as a close ally of *Veronica* (e.g., Endlicher, 1836-40). In that year, however, Bentham (1846) excluded *Lagotis* from the Scrophulariaceae and referred it, though with uncertainty, to the Selaginaceae on the basis of the structure of its fruit. Choisy (1848), in his monograph of the Selaginaceae, wrote that an affinity of *Lagotis* with this family of the basis of fruit structure is not to be denied but that most of the floral characters (e.g., distinctly bilabiate corolla, capitate stigma) of *Lagotis,* as well as its habit and distinct geographical distribution, indicate the contrary. In Choisy's opinion the assignment of *Lagotis* to the Selaginaceae appears to be less natural than its assignment as a near ally of *Veronica.* Nevertheless, it was treated under the Selaginaceae by Choisy and by many subsequent authors (Bentham and Hooker, 1876; Gray, 1886; Hooker, 1885; Printz, 1921; Rolfe, 1883; Van Tieghem, 1891). In his *Histoire des Plantes,* Baillon (1888) restored *Lagotis* to its position in the Digitaleae near *Veronica.* In this he was followed by Wettstein (1891) in *Die Natürlichen Pflanzenfamilien.* This transfer was at first opposed by Hallier (1901) but subsequently accepted and defended by him (1903). Indeed, Hallier's discussion of the systematic position of *Lagotis* is the most critical and detailed in print. He referred to *Lagotis* as ". . . nichts anderes, als eine im Fruchtknoten

und der Zahl der Samenknospen stark reduzierte, im Uebrigen nur noch durch grössere Brakteen ausgezeichnete Sektion von *Wulfenia.*" Of the long accepted alliance of *Lagotis* with the Selagineae he stated: "In Tracht and geographischer Verbreitung ist *Lagotis* von den eigentlichen Selagineen grundverschieden; das wenige, was sie mit ihnen gemein hat, nämlich der in jedem Fach nur noch eine einzige hängende Samenknospe enthaltende Fruchtknoten, beruht wohl mehr auf einer parallelen, auf gleicher Stufe angelangten Reduktion, als auf engerer Verwandtschaft." Since *Lagotis* was included in the Digitaleae sensu Wettstein, it has been treated as a *Veronica* ally by most authors.

Apparently previously unobserved or unreported is an interesting feature of the genus *Lagotis;* the posterior lobes of the corolla are external in the bud. This characteristic, if the relative position of the corolla lobes in aestivation be used as the basis upon which to define the subfamilies of the Scrophulariaceae, would exclude *Lagotis* from the Rhinanthoideae, the sub-family wherein are found *Veronica* and allies. Since *Lagotis* is surely an ally of *Veronica*, as Hallier so clearly demonstrated, aestivation characteristics in this case seem to be of little importance in establishing relationships (compare Diels, 1897, and Hartl, 1955).

Now that we have reviewed some of the major taxonomic problems in the Scrophulariaceae—and some of the major changes made in the classification of the family since Wettstein's revision of it—we may well ask ourselves, "What does all this mean?" Obviously, the most important fact gleaned from such a review is that the Scrophulariaceae, generally considered such a "well-known" family, are far from being "well-known." A satisfactory tribal classification of the family has not yet been attained; even the limits of the family are not agreed upon. Next we might ask ourselves, "Where do we go from here?" The course, to me at least, is clear. A world monograph of the Scrophulariaceae on the generic level, making use of all available collections and all techniques available to the modern taxonomist, should provide the data prerequisite to a logical treatment of the family. Most of today's taxonomists are so concerned with studies of genera or of floras of limited areas that the larger problems—such as supra-specific classification of the Scrophulariaceae—are neglected. Such neglect is, of course, understandable when one realizes that the neglected problems are often those whose study requires the assembling of a vast amount of herbarium material from the world over. Such assemblage has its *own* problems of expense, storage, etc., that perhaps few herbaria and taxonomists are able to cope with. Nevertheless, the collections for such studies *are* available; perhaps someday someone will conceive of a way to use them. (see Just, 1953, for an able discussion that is applicable here.) It should be apparent to all that, in the Scrophulariaceae at least, the work of the taxonomist has just begun.

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STUDIES IN THE COMPOSITAE-EUPATORIEAE, V. NOTES ON THE GENUS PIQUERIA

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PIQUERIA **pittieri** R. M. King, nom. nov. (Compositae-Eupatorieae). Based on *P. longipetiolata* B. L. Rob**inson,** Proc. Amer. Acad. 43:27. 1907. (Not *P. longipetiolata* Sch.-Bip. ex Baker in Mart., Fl. Bras. 6/2:-182. 1876). This Colombian species is one of the most distinct in the genus The corolla is narrowly tubular at the base becoming abruptly broadly campanulate at the point of insertion of the filaments.

As a result of the examination of specimens in the U.S. National Herbarium determined as *P. serrata,* the following correction is made. In 1964, Turner and King reported a chromosome count of $n = 11$ for a specimen identified as *P. serrata* A. Gray *(King & Soderstrom 4605).* The specimen should have been determined as *P. trinervia* Cav.

PIQUERIA **hintonii** R. M. King sp. nov.

Caudex et folia simulans *P. serrata* A. Gray. Folia membranacea. Apex phyllarii longus, distinctus. Corolla alba, extus basi pubescens, cellulae setarum uniseriatae, lobi corollae breves *ca* 1 mm. longi *ca* .6 mm. lati. Stamina filamentis ubique pubescentibus. Achaenia basi subrecta.

Shrub to perhaps one meter or more tall, with many long slender glabrous branches; stem single, erect, striate; leaves thin, glabrous, opposite, ovate-lanceolate, sessile or sub-sessile, the margins serrate; blades up to 3.5 cm broad, up to 10 cm long; inflorescence corymbose; heads discoid, campanulate, 2-3 mm. broad, *ca* 5 mm tall (including style branches), 3-8 (10) flowered, receptacle slightly convex naked, phyllaries 5, scarious, ovate-obtuse with a distinct apiculum, *ca* 3.5 mm. high, *ca* 1 mm. wide, florets white, narrowly funnelform, *ca* 1.25 mm. long (including lobes), 5 lobed (lobes distinctly less than twice as long as wide), base of corolla externally with numerous uniseriate hairs (largely eglandular); stamen 5; anthers unappendaged, *ca* 1 mm. long, *ca* 25 mm. wide, filaments *ca* 50μ wide *ca* 1 mm. long, covered with numerous hairlike projections throughout the length of the filament. Pappus lacking. Achenes prismatic 5 ribbed, glabrous, dark brown or black. Base of achene nearly straight. Pollen spherical, tricolpate, distinctly spinose, *ca* 20μ in diameter. Chromosome number not determined.

P. hintonii is one of a group of Mexican species showing more or less pubescent filaments on the stamens. The only other species in this

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group with the base of the achene straight is *P. serrata* A. Gray which differs as shown in the following table:

P. hintonii	*P. serrata*
1. Corolla lobes distinctly less than twice as long as wide.	1. Corolla lobes more than twice as long as wide.
2. External base of corolla with only uniseriate hairs.	2. External base of corolla with many biseriate hairs.
3. Filaments covered with numerous hairlike projections throughout.	3. Filaments with hairs only on basal part.
4. Phyllaries with a distinct apiculum projecting beyond the marginal teeth.	4. Phyllaries with an obscure apiculum immersed among the marginal teeth.

In addition to the above differences, dried herbarium specimens of *P. hintonii* appear to have leaves of a thinner texture than *P. serrata.*

Holotype in the U. S. National Herbarium (1844661) *G. B. Hinton 3517* Cajones, District of Temascaltepec, State of Mexico, Mexico.

REFERENCE

TURNER, B. L. AND R. M. KING. 1964. Chromosome Numbers in the Compositae. VIII. Mexican and Central American Species. Southw. Nat. 9: 27-39

Plate I. *Piqueria hintonii* R. M. King Holotype (US) *G. B. Hinton 3517*

TAXONOMY OF GYMNOLAENA (DC.) RYDB. (COMPOSITAE: TAGETEAE)

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In his revision of *Dyssodia*, De Candolle (1836) placed *Dyssodia serratifolia* in the section *Gymnolaena*, naming the section for the absence of calyculum. Rydberg (1915) elevated the section to generic rank and recognized four taxa: *Gymnolaena serratifolia, G. oaxacana, G. integrifolia* and *G. seleri.* While studying specimens of these taxa as part of routine herbarium work preliminary to the preparation of a monograph of *Dyssodia,* I found that two of Rydberg's combinations are synonyms for species of *Dyssodia.* These names are, therefore, excluded from *Gymnolaena* and listed as such below. The remaining species and a third described in this treatment make up, in my judgement, a neat, quite distinct genus, *Gymnolaena.*

Gymnolaena combines in a unique manner some of the most salient characters of *Dyssodia* and *Tagetes* as shown in the following list:

Dyssodia (*Eudysodia* sensu O. Hoffm. 1894)	*Gymnolaena*	*Tagetes*
Leaves rarely with glands scattered over the lamina	Glands scattered over the lamina	Glands scattered over the lamina
Capitula borne singly	Capitula borne singly or in cymose clusters	Capitula borne singly or in cymose clusters
Calyculum usually present	Calyculum absent or very reduced	Calyculum absent
Phyllaries biseriate	Phyllaries uniseriate	Phyllaries uniseriate
Phyllaries free or partially connate	Phyllaries connate high up	Phyllaries connate high up
Receptacle fimbrillate	Receptacle foveolate, naked or minutely fimbrillate	Receptacle foveolate, naked
Pappus usually of dissected squamellae	Pappus of dissected squamellae	Pappus of truncate and aristate scales
Style branches with long, subulate appendages	Style branches with long, subulate appendages	Style branches truncate or with short, conic appendages

It is apparent that *Gymnolaena* can not be comfortably included in either *Dyssodia* or *Tagetes.* The three genera are consequently maintained with *Gymnolaena* occupying an intermediate position between *Tagetes* and *Dyssodia.*

GYMNOLAENA (DC.) Rydb., N. Am. Fl. 34:160. 1836.

Dyssodia sect. *Gymnolaena* DC., Prodr. 5:641. 1836.

Glabrous or puberulent shrubs, 1.0-2.4 m high. Leaves opposite (both opposite and alternate in one specimen of *G. oaxacana, Smith 384,* GH), simple, subsessile to short-petioled, lanceolate to ovate, serrate, glabrous to puberulent, glandulose. Heads peduncled, single or in cymose clusters; calyculum absent or of 1-3 inconspicuous linear bracts; involucre cylin-

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dric, 1-2 cm high, 5-10 mm through; phyllaries 5-13, uniseriate, connate nearly to the tips, streaked with glands. Receptacle convex, foveolate, naked or minutely fimbrillate. Rays 5-12, yellow to red-orange, pistillate, fertile; disc florets 10-40, perfect, corollas 9-12 mm long, tube and throat slender, about equal, tube puberulent lobes slender, unequal; style branches with long, subulate appendages. Pappus of 15-20 squamellae, each dissected into 5-10 unequal bristles; achenes obpyramidal, 4-6 mm long, pubescent. Type species: *Dyssodia serratifolia* DC.

Key to species of *Gymnolaena.*

1. Capitula borne in cymose clusters at the tips of branches; involucre 10-12 mm high; phyllaries ca 5. . . . . 1. *G. serratifolia*
1. Capitula borne singly; involucre more than 12 mm high; phyllaries 6-13.
   2. Leaves 2-5 (-9) cm long; phyllaries 6-9, each with 4-9 elongate-linear glands. . . . . 2. *G. oaxacana*
   2. Leaves (5-) 8-15 cm long; phyllaries ca 13, each with 11-25 short, elliptic glands. . . . . 3. *G. chiapasana*

1. GYMNOLAENA SERRATIFOLIA (DC.) Rydb., N. Am. Fl. 34:161. 1915.

Dyssodia serratifolia DC., Prodr. 5:641. 1836. HOLOTYPE (G, not seen): Mexico. "Oaxaca ad Atitla et locos vicinos," *Alaman s.n.* Phototypes: F! GH! MO! US!

Hymenatherum serratifolium (DC.) Hemsl., Biol. Cent. Amer. Bot. 2:221. 1881.

Glabrous shrubs to 2 m high. Leaves opposite, slenderly elliptic to lanceolate, 3-8 cm long, 1-2 cm wide, short petioled, dotted with numerous small glands, margins finely serrate. Heads borne in cymose clusters at the tips of branches, peduncles 1-3 (-5) cm long, 3-4 bracteate, the bracts 2-4 mm long, bearing 1-3 small, swollen glands; calyculum of 0-3 small, inconspicuous bracts, similar to those of the peduncles; involucre cylindric, 10-12 mm high, 4-5 mm through; phyllaries 5, in a single series, connate up to the short, deltoid, puberulent tips, each phyllary streaked with 2-4 vertical rows of elongate glands each basally indurate. Receptacle flat to convex, short-fimbrillate. Ray florets 5 (-8), corollas yellow, tube 5-6 mm long, puberulent, lamina 4-5 mm long, 3-4 mm wide; disc florets 10-20 corollas dull yellow with dark veins, 9 mm long, tube ca 3 mm long, puberulent, throat only slightly dilated, lobes lanceolate, unequal, 1.5-2.5 mm long; style branches bearing long, hispidulous, subulate appendages. Pappus of 15-20 squamellae, each dissected into 5-9 bristles 6-9 mm long; achenes obpyramidal, ca 4 mm long, appressed hirsute.

Distribution (Fig. 1): Known only from three collections from central Oaxaca; ca 1700 m.

Specimens examined: Oaxaca; Matatlan, Dist. de Tlacolula, 13 Aug 1920, *C. Conzatti 4033* (US); Near Mitla, Oaxaca Valley, 13 Nov 1894,

C. L. Smith 378 (MICH, MO, NY, TEX).

2. GYMNOLAENA OAXACANA (Greenm.) Rydb., N. Am. Fl. 34:160. 1915.

Dyssodia oaxacana Greenm., Field Mus. Pub. Bot. 2:273. 1907. HOLOTYPE (F!): Mexico. Almoloyas, Oaxaca, 25 Dec 1906, *C. Conzatti 1653*. ("fragment in hb. De Candolle", not seen)

Shrubs, 1.0-2.4 m high; young stems terete, puberulent, weakly striate. Leaves opposite (sometimes alternate in the same plant), simple, ovate to lanceolate, 2-9 cm long, 6-12 (-30) cm wide, serrate to dentate, glabrous to sparsely puberulent, dotted with numerous glands scattered over the blade, usually with a gland in each cusp of the margins. Peduncles solitary, 3-5 (-12) cm long, 3-4 (-10) bracteate, swollen just beneath the heads; calyculum of 0-3 linear-subulate bracts, 3-4 mm long, bearing 1-3 subterminal glands; involucre cylindric, 12-15 (-18) mm high, ca 5 mm through; phyllaries 6-9, usually 8, in a single series, united almost to the short, deltoid, puberulent tips, each phyllary basally indurate, streaked with 4-9 conspicuous, elongate-linear glands, splitting to the base in 2's and 3's at maturity. Receptacle convex to conic, foveolate, naked or minutely fimbrillate. Ray florets 8 or fewer, corollas orange, tube ca 5 mm long, slender, sparsely puberulent lamina oval-elliptic, 7-9 mm long, 3-5 mm wide; disc florets 15-30, corollas dull yellow, 9-10 (-12) mm long, slender, tube ca 4 mm long, sparsely puberulent, lobes unequal, 1-2 mm long, style branches with long, subulate appendages. Pappus of ca 20 squamellae, each dissected into 5-9 bristles, the central bristle longer and coarser than the lateral ones, about equalling the disc corollas; achenes slender, obpyramidal, 6 mm long, subsericeous.

Distribution (Fig. 1): Among rocks on gravelly soils; thorn-scrub to semi-evergreen forests; southern Puebla and northern Oaxaca; 800-1800 m. Jul.-Dec.

Specimens examined: Oaxaca: Between Nochixtlan and Parian, 20-23 Dec 1936, *W. H. Camp 2558* (NY); Dist. Nochixtlan, 12 Oct. 1921, *C. Conzatti 4251* (US); Las Hoyas Canyon, 2 Nov 1894, *C. G. Pringle 6028* (BM, F, GH, LE, MICH, MO, MSC, NY, US); "Cuauhtlilla", 28 nov 1895, *C. & E. Seler 1535* (NY, US); Below Jayacatlan, 9 Feb 1895, *L. C. Smith 384* (GH). Puebla: Rocks, Cerro de Coatepe, Aug 1907, *C. A. Purpus 2535* (UC); Coxcatlan, Sept 1909, *C. A. Purpus 4119* (BM, F, GH, MO, NY, UC, US); Las Salinas, near Zapotitlan, Sept 1911, *C. A. Purpus 5621 (*BM, F, GH, MO, NY, UC, US); Tehuacan area, above Calipan, along Barranca de los Mangos, 13 Jul 1961, *C. E. Smith et al.* 3743 (F, GH, NY).

3. GYMNOALENA **chiapasana** Strother, sp. nov.

HOLOTYPE (BM!): Mexico. Chiapas, etc., ann. 1864-1870, *Ghiesbreght 519*. Isotypes: GH! MO! NY!

Folia lanceolata attenuata (5-) 8-15 cm. longa 1.5-3.5 cm. lata. In-

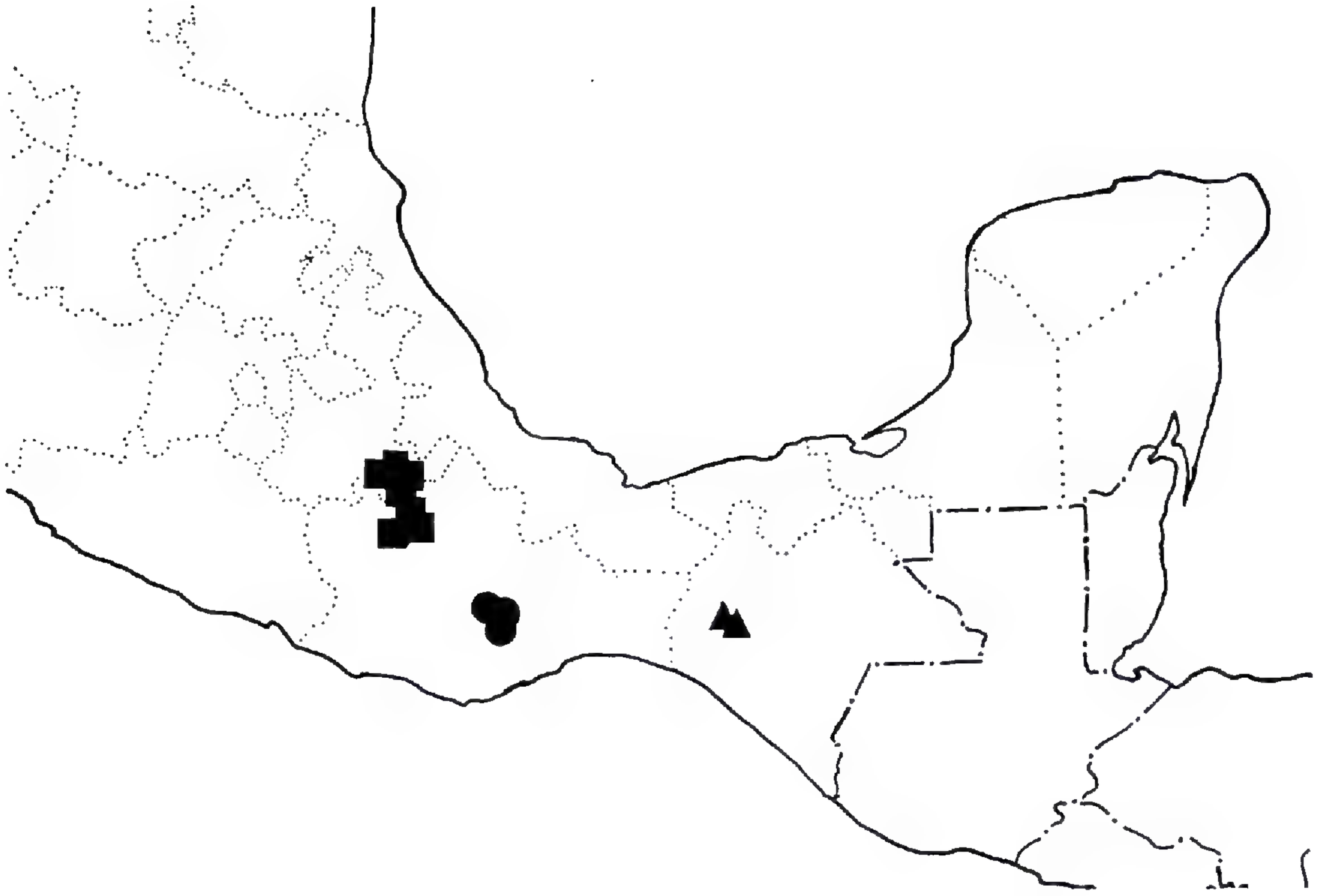

Fig. 1. Distribution of *Gymnolaena* as shown by herbarium records. Squares indicate *G. oaxacana*, circles *G. serratifolia* and triangles *G. chiapasana*.

volucra 17-20 mm. alta; phyllaria ca. 13 glandulis parvis ellipticis numerosis (11-25) ornata. Receptaculum breviter conicum foveolatum. Flores radii 8-12, disci 30-40.

Shrubs; stems striate, glabrous. Leaves opposite, lanceolate, attenuate, (5-) 8-15 cm long, 1.5-3.5 cm wide, serrate, subsessile, bearing 2-4 lance-subulate lobes (3-8 mm long) at the base, dotted with numerous, tiny glands. Peduncles 2-10 cm long, glabrous, striate, swollen beneath the capitula, bearing 5-11 linear bracts ca 6 mm long; calyculum of 0-3 linear bracts similar to those of the peduncle; involucre 17-20 mm high, 8-10 mm through; phyllaries ca 13, in one series, united nearly to the minutely crisp-hairy tips, each with numerous (11-25), small, elliptic glands. Receptacle a short, foveolate cone. Ray florets 8-12, corollas red-orange, tube slender, 6-7 mm long, puberulent lamina elliptic 7-8 mm long, 3-4 mm wide; disc florets 30-40, corollas ca 9 mm long, slender, minutely puberulent, tube 5 mm long, lobes linear-lanceolate, ca 1.5 mm long; style branches bearing long, subulate, hispidulous appendages. Pappus of 15-20 squamellae, each dissected into 7-10 bristles, the longest 9-11 mm; achenes slender, rather clavate, 6 mm long, black, subsericeous.

Distribution (Fig. 1): Known only from the collections cited.

Specimen examined in addition to the type and isotypes: Chiapas: Barranca between S. Fernando and S. Cristobal, west of Tuxtla Gutierrez, 1 Feb 1949, *I. K. Langman 3837* (US).

Gymnolaena chiapasana is closely related to *G. oaxacana* from which it is distinguished by its larger heads, greater number of florets, more numerous and more glandular phyllaries and larger leaves with short basal lobes.

Excluded Species

Gymnolaena seleri (Rob. & Greenm.) Rydb.=*Dyssodia grandiflora* DC.
Gymnolaena integrifolia (Gray) Rydb.=*Dyssodia montana* (Benth.) Gray

Acknowledgements

I am indebted to Dr. L. H. Shinners for supplying the Latin diagnosis for *Gymnolaena chiapasana* and to the several curators responsible for the loan of materials without which this study would not have been possible.

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DE CANDOLLE, A. P. 1836. [Dysodia.] Prodr. 5:639-641.
HOFFMAN, O. 1894. [Dysodia.] In Engler and Prantl, Natürl. Pflanzenfam. 4.5:265-266.
RYDBERG, P. A. 1915. [Carduaceae-Tageteae.] N .Am. Fl. 34:147-216.

NOTES

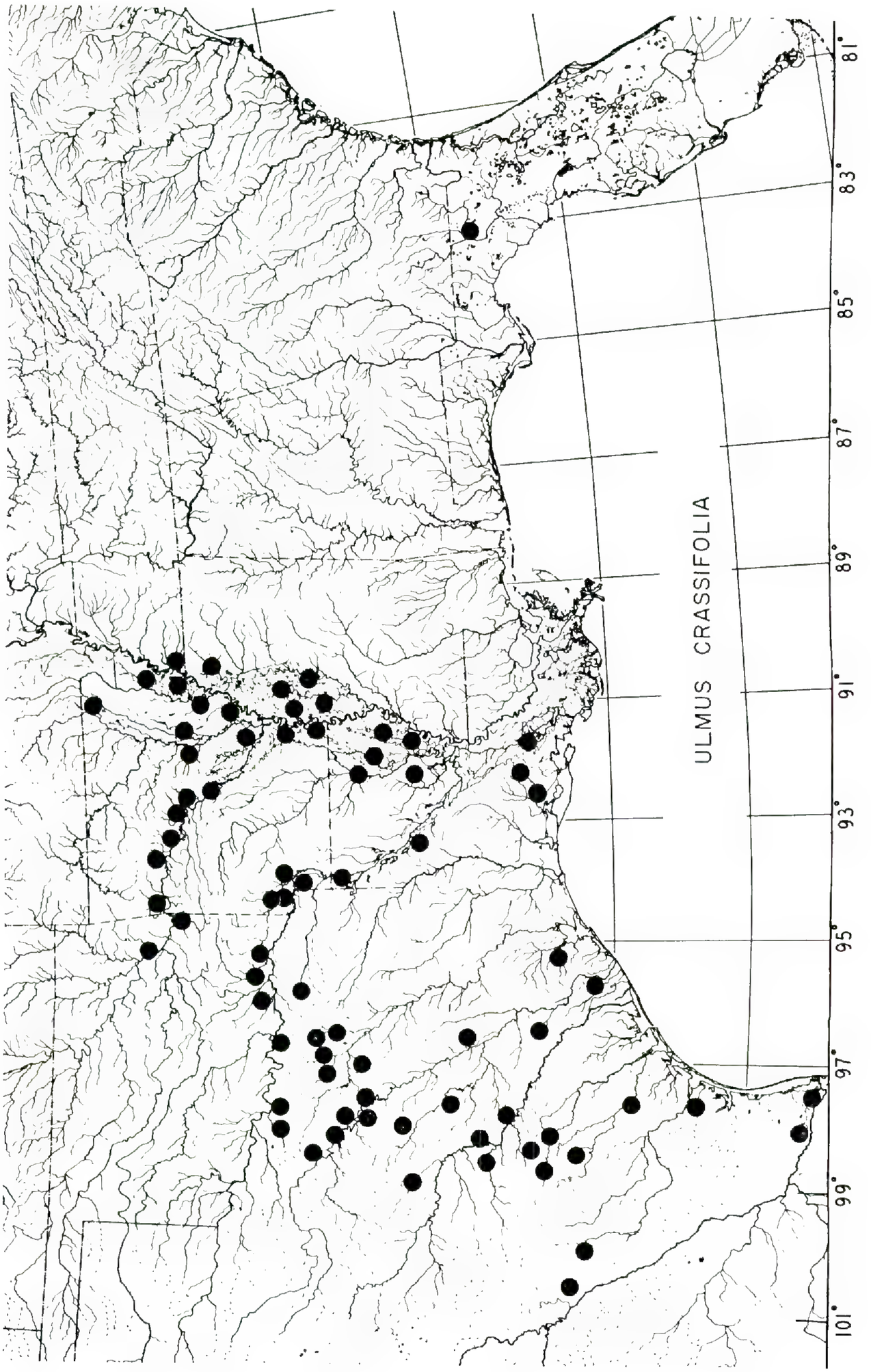
ULMUS CRASSIFOLIA (ULMACEAE) IN FLORIDA.—*Ulmus crassifolia* Nutt. is previously unknown east of Mississippi and Louisiana. The accompanying distribution map emphasizes the apparent disjunct nature of the trees at Suwannee River State Park, Florida. The small, scabrous obtuse or acute leaves, the corky-winged stems, and the characteristic bark of large reflexed plates were sufficient to identify sterile material collected in 1965. Fruiting material obtained in the fall of 1966 verified this determination.

The Florida locality is similar to areas in the Mississippi River floodplain. *Carya aquatica* (Michx. f.) Nutt. and *Planera aquatica* Gmel. are common associates in both areas. The soil at the site in Florida is similar to the heavy clay gumbos of river bottoms in eastern Arkansas, northwestern Mississippi, and northeastern Louisiana where *Ulmus crassifolia* may sometimes be a common species.

Ulmus crassifolia in Suwannee River State Park occurs over a moderately extensive area undoubtedly at times inundated by the Suwannee River. Individuals of this species occurring there range in size from seedlings to trees 15 meters or more in height.

Duplicates of the material here cited will be distributed. FLORIDA, Suwannee Co.; Suwannee River State Park near Ellaville, T1S, R12E, Sect. 18, numerous trees near creek flowing into Suwannee River, with *Planera aquatica* and *Carya aquatica*, October 3, 1965, *Sidney McDaniel & Camm Swift 7019* (FSU), November 12, 1966, *McDaniel 8002* (FSU).—*Sidney McDaniel, Dept. of Biological Science, Florida State University, Tallahassee, Florida 32306.*

BRUNNICHIA OVATA (WALTER) SHINNERS, COMB. NOV. (POLYGONACEAE).—Based on *Rajania ovata* Walter, Fl. Car. p. 247. 1788 (June). Type not seen and description scanty, but Meisner (in DC., Prodr. 14: 185, 1856) includes this as a synonym of *B. cirrhosa* (incorrectly giving the page as 198 and spelling the generic name *Rayania)* and cites that species from "In Carolina (Fraser! Bosc!)," so that he presumably saw an authentic specimen. Another *Rajania ovata* was published ostensibly in the same year by Swartz, Prodr. p. 59, but this did not in fact appear before 1789 (cf. Urban, Symb. Ant. 1: 163, 1898), and Swartz's species will require another name.—*Brunnichia cirrhosa* Gaertner De Fruct. et Semin. Pl. 1: 214 (with pl. 45 f. 2). "1788" but not actually distributed until April or May, 1789 (cf. Brizicky, Rhodora 62: 83, 1960). Acceptance of title-page dates which were not in fact the exact dates of issue has been responsible for the long neglect of the oldest name for this species, that of Walter.—*Lloyd H. Shinners.*


ULMUS CRASSIFOLIA
81°
83°
85°
87°
89°
91°
93°
95°
97°
99°
101°

SPECIES OF BILDERDYKIA (TINIARIA, POLYGONUM IN PART) TRANSFERRED TO REYNOUTRIA (POLYGONACEAE).—In his valuable paper "Pollen morphology in the genus Polygonum L. s. lat. and its taxonomical significance" (Svensk Bot. Tidskr. 40: 371-404, 1946), Olov Hedberg concludes that several segregates should be recognized. The principal ones in the southern United States are *Persicaria* and *Bilderdykia*. For the last-named genus he adopts the later synonym *Tiniaria* on the grounds that it is better known, and proposes it for conservation. It has not, however, been added to the official list of *nomina conservanda*. Hedberg observes further that *Reynoutria (Pleuropterus)* is not generically separable, a conclusion also reached earlier by Heintze and Danser. The recently published volume 1 of Flora Europaea (1964) treats *Polygonum* and segregates in a peculiar manner, rejecting *Persicaria* but adopting both *Bilderdykia* and *Reynoutria* (pp. 76-81). Hedberg's treatment seems to me decidedly preferable. Since none of the names has been conserved, the oldest one, *Reynoutria,* must be adopted, and several new combinations become necessary. Since no recent American manuals use *Reynoutria,* both the new combinations and those already made for species found in North America are listed below.

REYNOUTRIA AUBERTII (L. Henry) Moldenke, Bull. Torr. Bot. Club 68: 675. 1941. *Polygonum Aubertii* L. Henry (originally *Auberti),* Rev. Hort. 1907: 82-83. (Not seen.) *Bilderdykia Aubertii* (L. Henry) Moldenke, Rev. Sudam. Bot. 6: 29. 1939. (Not seen.)

R. **baldschuanica** (Regel) Shinners, comb. nov. *Polygonum baldschuanicum* Regel, Acta Horti Petrop. 8: 684. 1884 *(fide* Index Kewensis; 1883 *fide* V. L. Komarov, Fl. U.R.S.S. 5: 690, 1936; original not seen.) *Bilderdykia baldschuanica* (Regel) Webb, Feddes Repert. 68: 188. 1963. (Not seen).

R. **cilinodis** (Michaux) Shinners, comb. nov. *Polygonum cilinode* Michx., Fl. Bor.-Am. 1: 241. 1803. *Tiniaria cilinodis* (Michx.) Small, Fl. S.E. U.S. 382, 1330. 1903. *Bilderdykia cilinodis* (Michx.) Greene, Leafl. Bot. Obs. & Crit. 1: 23. 1904.

R. **Convolvulus** (L.) Shinners, comb. nov. *Polygonum Convolvulus* L., Sp. Pl. 1: 364. 1753. *Bilderdykia Convolvulus* (L.) Dumortier, Florula Belgica p. 18. 1827. *Tiniaria Convolvulus* (L.) Webb & Moquin ex Webb & Berthelot, Hist. Nat. Iles Canaries t. 3 ptie. 2 (Phyt. Canar.) p. 221. 1841. (Not seen.)

R. JAPONICA Houttuyn, Nat. Hist. II. 8: 640. 1777. (Original not seen; description and plate reproduced by Danser in Bull. Jard. Bot. Buitenzorg ser. III, 8: 26-27, 1926. See Merrill in Rhodora 40: 290-291, 1938, for discussion.) *Polygonum cuspidatum* Siebold & Zuccarini, Abh. Akad. Muenchen 4 pt. 2: 208. 1846. (Not seen; taken from Merrill.)

R. SACHALINENSIS (F. Schmidt) Nakai in Mori, Enum. Pl. Corea p. 135. 1922. (Not seen.) *Polygonum sachalinense* F. Schmidt ex Maxim., Prim. Fl. Amur. p. 233. 1859. (Not seen.)

R. **scandens** (L.) Shinners, comb. nov. *Polygonum scandens* L., Sp. Pl. 1: 364-365. 1753. *Tiniaria scandens* (L.) Small, Fl. S.E. U.S. 382, 1330. 1903. *Bilderdykia scandens* (L.) Greene, Leafl. Bot. Obs. & Crit. 1: 23. 1904.

R. SCANDENS var. **cristata** (Engelm. & Gray) Shinners, comb. nov. *Polygonum cristatum* Engelm. & Gray, Pl. Lindh. 51 (Boston Journ. Nat. Hist. 5: 259). 1845. Type locality, near Industry, Austin Co., Texas. *Tiniaria cristata* (Engelm. & Gray) Small Fl. S.E. U.S. 382, 1330. 1903. *Bilderdykia cristata* (Engelm. & Gray) Greene, Leafl. Bot. Obs. & Crit. 1: 23. 1904. *Polygonum scandens* var. *cristatum* (Engelm. & Gray) Gleason, Phytologia 4: 23. 1952.

R. SCANDENS var. **dumetorum** (L.) Shinners, comb. nov. *Polygonum dumetorum* L., Sp. Pl. (ed. 2) 1: 522. 1762. *Bilderdykia dumetorum* (L.) Dumortier, Florula Belgica p. 18. 1827. *Tiniaria dumetorum* (L.) Opiz, Seznam p. 98. 1852. (Not seen.) *Polygonum scandens* var. *dumetorum* (L.) Gleason, Phytologia 4: 23. 1952.—*Lloyd H. Shinners.*

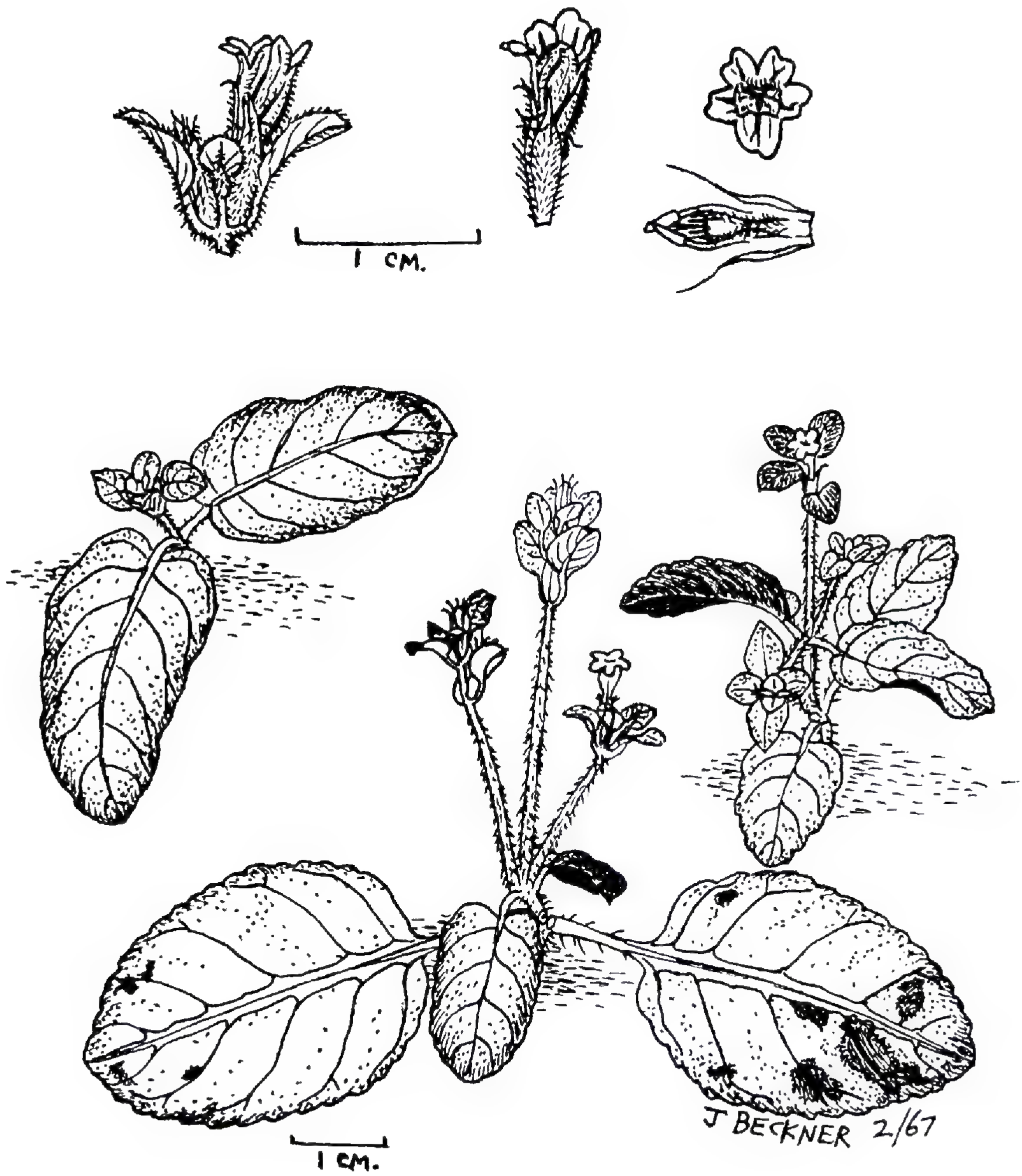
HEMIGRAPHIS REPTANS (ACANTHACEAE), A NEW FLORIDA WEED.—For at least a decade, orchid growers and other greenhouse owners in Florida have noticed a peculiar little weedy plant that invades pots of soil or epiphytic mixes. It sometimes appears on treefern slabs and totems, especially if these are kept moist. The disproportionately long roots and odd leaf colors make the plant noticeable, although it is not really a serious pest.

Graf's Exotica is the only publication where notice has been taken of this plant. In Exotica I, it is shown as *Allophyton evolutum* (J. D. Smith) Pennell, a member of the Scrophulariaceae from Chiapas, Mexico. The plant appears to be in the Acanthaceae, however, and Exotica III has it listed as *Ruellia blumei* Steud. of Java. This name is a nomen nudum.

Recently, Dr. D. B. Ward and I decided to pursue the matter further. A sample of the plants from the University of Florida's Botany Department greenhouse was sent to Dr. Stanwyn G. Shetler, of the Smithsonian Institution. After conferring with Dr. Dieter Wasshausen, of their staff, he kindly reported that this plant is *Hemigraphis reptans* T. Anders., a relative of *Ruellia* in the Acanthaceae.

Hemigraphis reptans was originally described from the Aru Islands off New Guinea. I have seen it in nearly every greenhouse and shadehouse in Florida and the Bahamas that I have visited. The plants have two or more large leaves forming a flat rosette at the base, with very reduced leaves up the scapes. The leaves are of a peculiar dull and discolored green, with deeper green to purplish veins, and purplish undersides. The tiny and inconspicuous flowers are a dirty lilac-white.

Two other species of *Hemigraphis* are often seen as house plants and in greenhouse collections. They are immediately distinguished from *H.*



reptans by possessing elongated stems with all the leaves of more or less uniform size. Both have shiny deep green leaves with red-purple undersides. *H. colorata* Hallier has leaves that are nearly plane. The other cultivated plant is currently known only as *H.* 'Exotica'. It has a denser habit than *H. colorata,* and the leaves are very strongly "crinkled" over their entire surface. Neither of these plants has been seen as an escape, but they can be expected in southern Florida.—*John Beckner, University of Florida, Gainesville.*

STRAY NOTES ON TEXAS PLANTAGO (PLANTAGINCEAE).—Two species are to be added to those recognized for Texas in my brief 1950 paper (The North Texas species of *Plantago* (Plantaginaceae), Field & Lab. 18: 113-119), and the three varieties of *P. Purshii* I now place under *P. patagonica*.

P. FASTIGIATA Morris, Bull. Torr. Bot. Club 27: 116-117. 1900. *P. insularis* Eastwood var. *fastigiata* (Morris) Jepson, Man. p. 926. 1925. Recently reported from Brewster County by Correll (Rhodora 68: 428, 1966). There are two earlier collections in the SMU Herbarium. One was annotated in 1954 by the late Dr. G. Thomas Robbins as *P. insularis* Eastwood, which is a later homonym (1898) of *P. insularis* (Godron) Nyman (described from Corsica). The second was annotated by Dr. Robbins as *P. Hookeriana* F. & M., but the sheet is mixed, containing one plant each of *P. Hookeriana* and *P. fastigiata*. Both collections are also from Brewster County: Floodplain of Tornillo Creek, near Hot Springs, Big Bend National Park, *J. F. & Perle Brenckle 51110*, 6 March 1951. Big Bend National Park, south of Terlingua Creek, *Eula Whitehouse 19631*, 14 April 1948. In general appearance *P. fastigiata* closely resembles *P. Hookeriana;* the two may be distinguished as follows.

Floral bracts elliptic-orbicular, the very broad scarious margins each markedly wider than the herbaceous central portion . *P. fastigiata*

Floral bracts oblong-ovate, the scarious margins each equalling or narrower than the herbaceous central portion . . . . *P. Hookeriana*

P. ELONGATA Pursh, Fl. Am. Sept. 2: 729. 1814. "In Upper Louisiana. *Bradbury.*" The type collection was made near present Macy, Thurston Co., northeastern Nebraska, according to I. J. Bassett (Taxonomy of North American Plantago L., section Micropsyllium Decne., Canadian Journ. Bot. 44: 467-479, 1966; notes on Pursh's type, p. 470).—*P. pusilla* Nuttall, Genera 1: 100. 1818. "On arid saline hills near the Missouri. Flowers in May." According to the account of Nuttall's travels given by Pennell (Bartonia 18: 1-51, 1936), Nuttall and Bradbury traveled up the Missouri River together in the spring of 1811, and during May progressed from its junction with the Platte (not far from present Omaha, Nebraska) to that with the White River in South Dakota. Thus the type of *P. elongata* Pursh (which he received from Bradbury) and that of *P. pusilla* Nuttall were collected at about the same time and in the same area, outside the range of *P. pusilla* as mapped by Bassett. Though Nuttall's holotype has not been located (Bassett rightly does not accept as types Nuttall specimens from Arkansas bearing this name), there can be little doubt that his plant is identical with that of Pursh. *P. elongata* is rather rare in Texas. I have seen specimens only from Denton, Grayson and Wichita counties, all in the far north-central part of the state. Bassett cites it from Brazos County; his map shows two localities south of the center of the state. With the help of his treatment and that by Cronquist in Gleason & Cronquist's Manual (pp. 462-464, 1963), I am able

to distinguish two of the three species lumped under *P. elongata* in my earlier account, as follows:

Corolla lobes becoming reflexed in age; taproot prominent, with few laterals . . . . . *P. elongata*

Corolla lobes becoming erect in age; taproot scarcely more prominent than the numerous laterals (plant usually appearing fibrous-rooted) . . . . . *P. hybrida*

P. HYBRIDA Barton, Compendium Florae Philadelphicae 2: 214. 1818. (Later in the year than Nuttall's Genera.) *P. pusilla* of authors, not Nuttall (which is the same as *P. elongata,* as noted above). Including *P. heterophylla* Nuttall, Trans. Amer. Philos. Soc. n.s. 5: 177-178. 1835. (See Foster, Rhodora 46: 156-157, 1944, regarding publication date.) *Littorella flexuosa* Raf., New Fl. N.A. 4: 12-13. 1838. This species is frequent in central and eastern Texas. Most recent authors have separated *P. heterophylla,* chiefly on the basis of more numerous seeds, but this does not seem to me to set off more than a poorly defined geographic variety, while such other differences as size of corolla lobes do not permit any separation in the material I have examined (48 sheets from 10 states). Those who wish to maintain *P. heterophylla* as distinct must look further into the identity of Barton's type, since he does not mention number of seeds in his description.

P. PATAGONICA Jacquin, Ic. Pl. Rar. 2: 9, t. 306. 1795. (See Schubert, Contrib. Gray Herb. 154: 3-23, 1945, for probable date.) Judging from published illustrations (Pilger, Pflanzenreich IV. 269 (Heft 102): 360, 1937; Cabrera, Man. Fl. Alrededores de Buenos Aires p. 438, 1953) and a single herbarium sheet at SMU *(Eyerdam et al., Calif. Bot. Gard. 2nd Exp. Andes No. 23993,* Argentina, Gob. Santa Cruz; 6 plants on sheet), Cronquist was correct in concluding that the South American plant is not specifically distinct from the North American *P. Purshii* R. & S. (Gleason & Cronquist, Man. p. 644, 1953). But none of the three varieties found in Texas is the same as var. *patagonica,* nor is a fourth variety occurring farther west. Their names are as follows.

P. PATAGONICA var. GNAPHALIOIDES (Nuttall) Gray, Man. (ed. 2) p. 269. 1856. *P. Purshii* R. & S., Syst. 3: 120. 1818 (March). *P. gnaphalioides* Nuttall (as *"gnaphaloides"),* Genera 1: 100. 1818 (May).

P. PATAGONICA var. SPINULOSA (Decaisne) Gray, Syn. Fl. N.A. 2 pt. 1: 391. 1878. (Cited there as "Gray, l.c.," meaning Manual ed. 2, Pacific R. R. Rept. 4, Bot. Calif. 1: but the varietal combination does not appear in these places, only the adoption of the species name *P. patagonica* for North American plants being stated.) *P. spinulosa* Decaisne in DC., Prodr. 13: 713. 1852. *P. Purshii* var. *spinulosa* (Decaisne) Shinners, Field & Lab. 18: 117. 1950.

P. PATAGONICA var. **breviscapa** (Shinners) Shinners, comb. nov. *P. Purshii* var. *breviscapa* Shinners, Field & Lab. 18: 118. 1950. Dr. Robbins thought this might be only a growth-form depending on habitat or

season, but it is definitely genetic, and is geographically restricted. Its short scapes are like those of var. *patagonica,* but it differs in having elongate floral bracts like those of var. *spinulosa.*

P. PATAGONICA var. **oblonga** (Morris) Shinners, comb. nov. *P. oblonga* Morris, Bull. Torr. Bot. Club 28: 119. 1901. *P. spinulosa* var *oblonga* (Morris) Poe, ibid. 55: 411. 1928. *P. Purshii* var. *picta* (Morris) Pilger, Pflanzenreich IV. 269 (Heft 102): 369. 1937. Pilger considered *oblonga* and *picta* to be varieties of different species, but they are hardly separable. If treated as the same, as is done by Munz (Calif. Fl. p. 408, 1959), the name *oblonga* is earlier in varietal rank. It is not known from Texas; the transfer is included here merly for completeness.—*Lloyd H. Shinners.*

TESSARIA SERICEA (NUTTALL) SHINNERS, COMB. NOV. (COMPOSITAE).—Based on *Polypappus sericeus* Nuttall, Journ. Acad. Phila. n.s. 1: 178. Aug. 1848. *Berthelotia sericea* (Nuttall) Rydberg, Bull. Torr. Bot. Club 33: 154. 1906. *Tessaria borealis* T. & G. ex Gray, Pl. Wright. 1: 102. 1852. *Pluchea borealis* (T. & G.) Gray, Proc. Amer. Acad. 17: 212. 1882. *Pluchea sericea* (Nuttall) Coville, Contrib. U.S. Nat. Herb. 4: 128. 1893. I am indebted to Dr. Marshall C. Johnston for calling my attention to the fact that although I have been using the above combination, it has never been formally published.—*Lloyd H. Shinners.*

BOOK NOTICE

TEXAS FLOWERS IN NATURAL COLORS. Eula Whitehouse. 212 pp., numerous illustrations (from water-color paintings) in color. Third edition, 1967. Dallas County Audubon Society, 5421 Drane Drive, Dallas, Texas 75209.—With both previous editions long out of print (and copies of the first running as high as $25 on the second-hand market), it is welcome news that the Dallas County Audubon Society has sponsored a new edition. In order to keep the price down, it is not being sold through bookstores or dealers. It may be obtained from the Society at the above address for $5.25 per copy, postpaid. Profits (if any) will go to the Society's Sanctuary fund.

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THIRTY ADDITIONS TO THE LOUISIANA FLORA

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The following taxa apparently have not previously been recorded to be a part of the Louisiana flora. Unless otherwise noted, specimens cited are on deposit in the Herbarium of the Department of Biology, University of Southwestern Louisiana (LAF). They were collected in connection with the Louisiana Flora Project, which was started at USL in 1962. Cooperation from the university and support from a National Science Foundation research grant (GB-4671) are gratefully acknowledged. Dr. Lloyd Shinners has, as usual, unstintingly given help when it was needed.

Thelypteris torresiana (Gaud.) Alston. St. Helena Parish: mixed woods, with beech, along Darling Creek, 11 miles northwest of Greensburg, *Thieret 24904*, 25 September 1966. Known also as *Dryopteris setigera*, this fern is spreading in the southeast from its original introduction in Florida, where it was first collected in 1906. The blades of my collection reach 83 cm. in length. Determination of the collection was by Dr. Warren Wagner.

Bromus mollis L. Jefferson Davis Parish: rocky disturbed soil along railroad about 1.5 mile east of Roanoke, *Thieret 22443*, 20 April 1966.

Panicum texanum Buckl. Bienville Parish: road margin, sandy clay, 3.5 miles west of Gibsland, *Shinners 21796*, 6 October 1955 (SMU); sandy field 4.5 miles northeast of Ashland, *Thieret 24231*, 24 August 1966. Red River Parish: weed in cotton and soybean fields just west of Coushatta, *Thieret 20650*, 19 September 1965.

Paspalum convexum Humb. et Bonpl. Iberia Parish: sandy soil at roadside, Weeks Island, *Thieret 21705*, 20 November 1965.

Trisetum interruptum Buckley. Acadia Parish: along railroad about 3.5 miles southwest of Crowley, *Thieret 22863*, 7 May 1966.

Xyris fimbriata Ell. St. Tammany Parish: roadside ditch 3.5 miles west of Hickory, *Thieret 21663*, 30 October 1965. This species was certainly to be expected in Louisiana since it occurs in Mississippi just across the Pearl River from St. Tammany Parish. The collection was determined by Dr. Kral, whose fine paper on *Xyris* was recently published in Sida (Kral, 1966).

Allium ampeloprasum L. Franklin Parish: several clumps in grazed field 1½ miles west of Chase, *Thieret 24001*, 29 June 1966. Richland Parish: grassy strip along fencerow just north of Bee Bayou, 4.5 miles west of Holly Ridge, *Thieret 23813*, 23 June 1966. This is a noble

species, with culms reaching 1.5 meters in height and with umbels up to 12 cm. in diameter. Its flat, scabrous-margined leaves extend 1/3 to ½ way up the stem. It is known locally as "garlic" and, indeed, is cultivated for its garlic-like offsets. The entire plant has an unpleasantly strong alliaceous odor. At the Bee Bayou locality the highway right-of-way had just been mowed. The farmer who had done the mowing told me that "garlic" had been common along the road. His assertion was borne out by the mephitic aroma of comminuted *Allium ampeloprasum* that pervaded the area.

Allium vineale L. Franklin Parish: along railroad right-of-way, Chase, *Thieret 23994*, 29 June 1966. This collection, having both flowers and bulbils in the inflorescence, is var. *vineale*.

Smilacina racemosa (L.) Desf. Claiborne Parish: mixed woods about 3¼ miles east of Summerfield, *Thieret 24686*, 30 August 1966.

Eriogonum vespinum Shinners. Caddo Parish: dry sandy open area along highway and railroad 2.5 miles south of Ida, *Thieret 24497*, 27 August 1966. Growing to 1.5 meter tall, the plants have a perianth that is yellowish green inside but white silky outside.

Polygonum cespitosum Blume var. *longisetum* (DeBruyn) Stewart. Evangeline Parish: edge of wooded campground, Chicot State Park, about 8 miles north of Ville Platte, *Thieret 21409*, 19 October 1965. Jefferson Davis Parish: roadside ditch about ½ mile south of Lacassine, *Thieret 25109*, 23 October 1966.

Amaranthus greggii S. Wats. Cameron Parish: Gulf of Mexico beach above high tide mark, about 3 miles east of Holly Beach, *Thieret 10028*, 20 October 1962. The species is found on coastal sand dunes or on sea beaches around the western end of the Gulf of Mexico from Yucatan to southwestern Louisiana.

Glinus lotoides L. Sabine Parish: low sandy areas, Many, *Delzie Demaree 48395*, 9 July 1963 (SMU). Two species of *Glinus* are now known to occur in Louisiana. They are most easily distinguished by their seeds, which are smooth in *G. radiatus* but minutely tuberculate in *G. lotoides*.

Delphinium virescens Nutt. Calcasieu Parish: prairie-like strip along railroad about 2 miles northeast of Vinton, *Thieret 22989*, 14 May 1966. Three species of *Delphinium* are now known to me from Louisiana: *D. ajacis*, *D. carolinianum*, and *D. virescens*.

Heuchera americana L. Caddo Parish: oak-pine woods on northwest facing slope about 4.5 miles northwest of Belcher, *Thieret 22647*, 23 April 1966. Although credited to Louisiana by Small (1933), no specimens from the state are cited by Rosendahl, Butters, and Lakela (1936) in their monograph of *Heuchera*.

Astragalus leptocarpus Torr. et Gray. Jackson Parish: roadside 3 miles north of Dodson, *Thieret 22213*, 3 April 1966. Winn Parish: sand along railroad, near Saline Bayou, 1.5 miles southeast of Goldonna, *Thieret 22751*, 24 April 1966. The suggestion by Turner (1959) that this

species might eventually be found in Louisiana has proved to be correct.

Zornia bracteata (Walt.) Gmel. Caddo Parish: dry sandy open area along highway and railroad 2.5 miles south of Ida, *Thieret 24492*, 27 August 1966. Of this species, Small (1933) says "Fla. to Tex." No Louisiana specimens were seen, however, by the recent monographer of the genus, Dr. Mohlenbrock (1961, 1962).

Phyllanthus fraternus Webster. Orleans Parish: in silty clay, in shade, Audubon Park, New Orleans, *Shinners 25709*, 2 November 1956 (SMU); weed in zoo in Audubon Park, New Orleans, *Thieret 19219*, 29 August 1966. Lafayette Parish: weed on USL campus, Lafayette, *Thieret 18222*, 14 September 1964. These collections of this weedy species, which is "presumably native to India" but "has been sparingly introduced into the West Indies" (Webster, 1955) constitute the first United States records of the taxon. My Audubon Park collection was determined by Grady L. Webster.

Corchorus aestuans L. Pointe Coupee Parish: roadside along east bank of Atchafalaya River opposite Krotz Springs, *Thieret 18089*, 1 August 1964. St. Landry Parish: roadside about 4 miles northwest of Grand Coteau, *Thieret 18351*, 24 September 1964. Lafayette Parish: old meander scar 5 miles northeast of Lafayette, *Thieret 16439*, 2 October 1963. This weedy species has been recorded previously, in southeastern United States, only from Florida and Alabama.

Elatine triandra Schkuhr var. *brachysperma* (Gray) Fassett. Cameron Parish: common in shallow muddy water in pasture run about 1 mile south of St. Peter Church, Hackberry, *F. M. Uhler* and *N. Hotchkiss 8173*, 26 May 1966. This collection has seeds with pits in rows of 11 to 14.

Myriophyllum spicatum L. Caddo Parish: very abundant in bay at east end of Cross Lake, Shreveport, *F .M. Uhler* and *N. Hotchkiss 8214*, 15 June 1966; shallow water of Caddo Lake at picnic ground just south of Oil City, *Thieret 24459*, 27 August 1966. Pointe Coupee Parish: abundant in False River, New Roads, *Thieret 24038*, 5 July 1966. This species, although almost cosmopolitan, is almost certainly an introduction to Louisiana. It is abundant enough in places to be a hindrance to boaters and fishermen. In our material the leaves are in 4s and 5s. I have not yet found flowering specimens in Louisiana.

Limnosciadium pumilum (Engelm. et Gray) Math. et Const. Cameron Parish: common in clayey silt at edge of roadside ditch 5 miles southeast of Lake Arthur, *F. M. Uhler* and *N. Hotchkiss 8165*, 25 May 1966. Acadia Parish: roadside ditch near Maxie, *Thieret 19532*, 18 April 1965. Jefferson Davis Parish: edge of roadside ditch 1.5 miles east of Roanoke, *Thieret 22447*, 20 April 1966. Described as "confined to Texas" by Mathias and Constance (1951), this species is locally common and conspicuous in roadside ditches in southwestern Louisiana.

Torilis arvensis (Huds.) Link. Morehouse Parish: roadside weed, Bas-

trop, *Thieret 23573*, 20 June 1966. Tensas Parish: fence row along highway about 3.5 miles west of Newellton, *Thieret 23968*, 29 June 1966.

Stylisma pickeringii (Torr. ex M. A. Curtis) Gray var. *pattersonii* (Fern. et Schub.) Myint. Caddo Parish: dry sandy open area along highway and railroad 2.5 miles south of Ida, *Thieret 24504*, 27 August 1966. In his recent revision of *Stylisma*, Myint (1966) states: "Whether *Stylisma pickeringii* grows in Louisiana has not been definitely determined, although a collection exists bearing the locality 'W. La.' (Hale GH, NY)." The presence of the species in the state has now been confirmed. The prostrate stems of our collection reached a length of nearly 2 meters.

Phacelia strictiflora (Engelm. et Gray) Gray var. *robbinsii* Const. Winn Parish: sand along railroad, near Saline Bayou, 1.5 miles southeast of Goldonna, *Thieret 22751*, 24 April 1966.

Scutellaria cardiophylla Engelm. et Gray. Caddo Parish: dry sandy open area along highway and railroad 2.5 miles south of Ida, *Thieret 24491*, 27 August 1966. This species was certainly to be expected in Louisiana because it occurs in far eastern Texas and in southwestern Arkansas.

Scutellaria drummondii Benth. Vernon Parish: railroad ballast, Hornbeck, *Thieret 22515*, 21 April 1966. This collection represents the easternmost station for the species, which previously had been known, in the United States, only from Texas and New Mexico.

Sherardia arvensis L. Bienville Parish: sandy clay road shoulder 4.3 miles west of Gibsland, *Shinners 23401*, 25 March 1962 (SMU); roadside near Lake Bistineau, about 6 miles west northwest of Ringgold, *Thieret 22703*, 24 April 1966. Grant Parish: forming dense growth in sand along small stream in open deciduous woods about 4 miles north of Bentley, *Thieret 22766*, 24 April 1966.

Specularia lamprosperma (McVaugh) Fern. Grant Parish: roadside along Bayou Rigolette about 2 miles east of Colfax, *Thieret 23217*, 27 May 1966. This species, first described in 1945, is known to occur in Texas, Oklahoma, Arkansas, Missouri, and, now, Louisiana.

Parthenium hispidum Raf. Bossier Parish: low ridges, Bossier City, *Demaree 20813*, 6 May 1956 (SMU). Webster Parish: grassy roadside 5 miles south of Doyline, *Thieret 24346*, 25 August 1966. A rhizomatous perennial, this species formed colonies up to about a meter across in the Webster Parish site.

Pyrrhopappus geiseri Shinners. La Salle Parish: highway right-of-way west side of Tullos, *Shinners 23991*, 16 June 1956 (SMU). Red River Parish: fencerow by bottomland pasture 1.4 mile west of Grand Bayou, *Shinners 27264*, 22 April 1958 (SMU). Caddo Parish: roadside at picnic area above shore of Caddo Lake just south of Oil City, *Thieret 22606*, 22 April 1966. The determination of my collection of this species was verified by Lloyd Shinners.

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CYPERUS SUBGENUS KYLLINGA (CYPERACEAE) IN THE CONTINENTAL UNITED STATES

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Six subgenera of *Cyperus* are recorded as occurring in the continental United States. Monographic studies including the United States species of three of these are available: *Eucyperus* (=*Cyperus)* (McGivney, 1938), *Mariscus* (Horvat, 1941), and *Pycreus* (Corcoran, 1941). We are preparing an account of the United States species of two additional subgenera, *Juncellus* and *Torulinium.* The present paper is a study of the remaining subgenus, *Kyllinga,* which is represented in the continental United States by four species, one *(C. brevifolioides)* being previously unreported for the New World. It is true, of course, that *Kyllinga* was studied in its entirety by Kükenthal (1936) in his voluminous work on *Cyperus* and that regional treatments of *Kyllinga* especially pertinent to our area have been published (Fernald, 1950; Gleason, 1952; Johnston, 1966; McLaughlin, 1944; Small, 1933). However, none of these works purports to cover adequately the taxonomy, variation, and distribution of United States *Kyllinga.*

The data presented in this paper are based upon field observations and upon study of about 1200 herbarium specimens. Our annotations on these specimens form a permanent record of our work. Our paper, therefore, contains only a very limited citation of specimens.

With the exception of that given for *C. brevifolioides,* synonymy is limited to those names that have been used for *Kyllinga* in certain major works directly applicable to continental United States. Full synonymy can be found in Kükenthal's monograph of *Cyperus* (Kükenthal, 1936). For *C. brevifolioides* we have given a full description, but for the other three species our descriptions are limited to those characteristics that we consider to be most diagnostic.

According to our field observations and to the many label data we have noted, the United States representatives of *Kyllinga* are somewhat weedy plants that occupy about the same wide range of habitats, including marshes, sand bars, swamp margins, pine savannas, low deciduous woods, lawns, gravel pits, mud flats, stream banks, pastures, lake shores, fallow or cultivated fields, and roadsides.

Illustrations of spikelets of our four species of *Kyllinga* are given in Figure 1; of achenes, in Figure 2. Distribution maps are given for all species.

SIDA 3 (3): 128—136. 1967.

We consider that mature achenes are necessary for critical determination of *Kyllinga*. The plants should be collected and mounted with their subterranean parts intact.

Cyperus L. subgenus *Kyllinga* (Rottb.) Suringar

Annuals or perennials; culms slender, leafy at the base; bracts usually 3-4, leaflike; heads of spikelets 1-3, terminal, sessile; spikelets many, deciduous from the rachis at maturity, consisting of 3 (-4) scales, the lowest 2 empty, the upper 1 (-2) fertile; scales 2-ranked; stamens 1-3; style bifid, deciduous from the achene; achenes usually lenticular but sometimes obscurely trigonous, 1 or occasionally 2 in a spikelet.

A. Plant rhizomatous ..... B.
A. Plant cespitose, culms densely aggregated ..... C.
  B. Scale keel smooth; stamens 2-3 ..... 1. *C. brevifolioides*
  B. Scale keel denticulate; stamen 1 ..... 2. *C. brevifolius*
C. Mature achene uniformly tan to light brown, oblong, 0.4-0.7 mm wide; scale keel denticulate ..... 3. *C. tenuifolius*
C. Mature achene purple black, with stipe and apiculus contrastingly light, obovate, 0.8-0.9 mm wide; scale keel denticulate or smooth ..... 4. *C. sesquiflorus*

1. CYPERUS **brevifolioides** Thieret et Delahoussaye, nom. nov.
Kyllinga monocephala Rottb. var. *leiolepis* Franch. et Sav., Enum. Pl. Japon. 2: 108. 1877.
Kyllinga gracillima Miquel, Ann. Mus. Bot. Lugd.-Batav. 2: 142. 1866; non *Cyperus gracillimus* (Chiovenda) Kükenth., 1936.
Kyllinga brevifolia Rottb. var. *gracillima* (Miquel) Kükenth., Meddel. Göteb. Bot. Trädg. 5: 107. 1929.
Cyperus brevifolius (Rottb.) Hassk. var. *gracillimus* (Miquel) Kükenth., Cypereae 603. 1936.
Kyllinga brevifolia (Rottb.) Hassk. var. *leiolepis* (Franch. et Sav.) Hara, Jour. Jap. Bot. 14: 339. 1938.
Cyperus brevifolius (Rottb.) Hassk. var. *leiolepis* (Franch. et Sav.) Koyama, Jour. Jap. Bot. 30: 126. 1955.

Similar in habit to *C. brevifolius;* rhizomatous perennial; roots fibrous, brown; rhizomes 1.0-1.5 mm thick, to at least 13 cm long, sheathed by overlapping, lanceolate, reddish scales ca. 13 mm long; culms 9-22 mm apart on the rhizome, 12.5-48.0 cm tall, slender, 0.5-1.0 mm broad at apex, 1-2 mm broad at base, triquetrous; leaves crowded at base of culm, 10-50 cm long, 1-3 mm wide; sheaths 1-3, usually reddish brown, 1-8 cm long; bracts 3-4, leaflike, 2-27 cm long; inflorescence a simple, compact, globular head of spikelets, 8-10 mm in diameter; spikelets 3.5-4.6 (mean 4.3) mm long, 1.2-1.3 (mean 1.22) mm wide; scale keel smooth, greenish to brown at maturity; stamens 2-3; anthers 0.8 mm long; filaments 2.3 mm long, hyaline when young, tan when mature; style ca. 2.1 mm long, the branches ca. 0.6 mm long; achene obovate, 1.5-1.8 mm long, 0.8-1.0 mm wide.

Figure 1. Spikelets of (left to right) *Cyperus brevifolioides, C. brevifolius, C. tenuifolius,* and *C. sesquiflorus.*

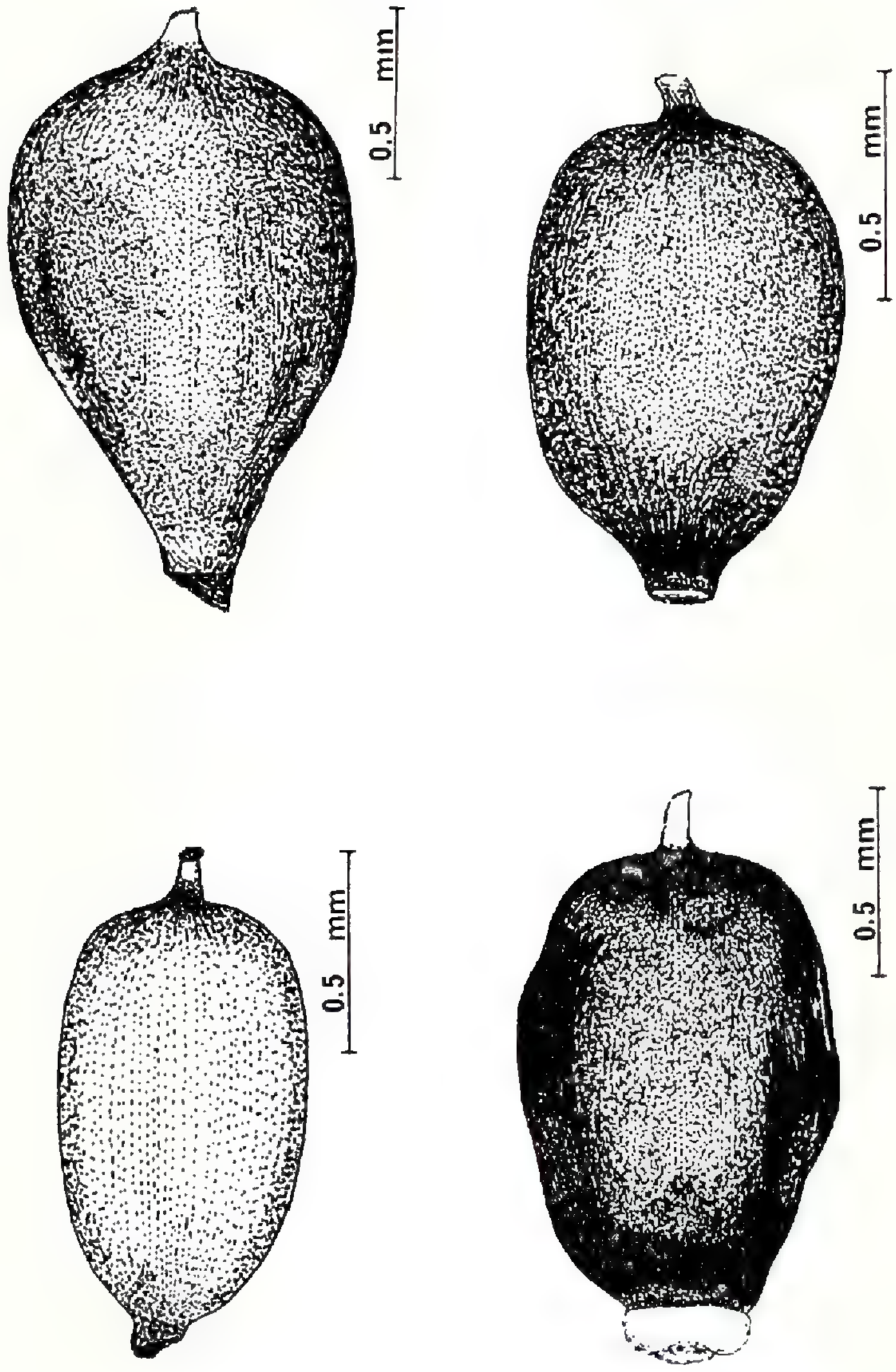


Figure 2. Achenes of *Cyperus brevifolioides* (top left), *C. brevifolius* (top right), *C. tenuifolius* (bottom left), and *C. sesquiflorus* (bottom right).

This is the taxon most recently known as *C. brevifolius* var. *leiolepis* and previously recorded only from far eastern Asia (Koyama, 1961; Ohwi, 1965). It is a well-marked taxon, one which we are most unwilling to accept as being only varietally distinguishable from *C. brevifolius* var. *brevifolius*. The choice of a name to designate it in its new rank has led us into quite unexpected byways. Eventually we concluded that no name in specific rank is available for it; we have chosen, therefore, to call it *C. brevifolioides*. Mention must be made here of the names *Kyllinga riederiana* Meinsh. ex Komar. (Fl. Penins. Kamtsch. 200. 1927.) and *K. kamtschatica* Meinsh. (Act. Hort. Petropol. 18: 229. 1901.) that are included by Koyama (1961) in synonymy under *C.*

brevifolius var. *leiolepis*. We cannot agree that these names are synonyms of *C. brevifolius* var. *leiolepis*. *Kyllinga riederiana* is a previously unpublished name that was merely cited by its author as a name *pro syn.* under *K. kamtschatica* and thus was not validly published. *Kyllinga kamtschatica* we regard as a synonym of *C. brevifolius* var. *brevifolius*, as borne out by the following statement from the original description of *K. kamtschatica:* "carina . . . spinoso-hispida." The "spinose-hispid" keel of *K. kamtschatica* excludes this taxon from consideration as a synonym of *C. brevifolius* var. *leiolepis*, a taxon distinguished by smooth scale keels.

Cyperus brevifolioides is, as its name implies, superficially quite similar to *C. brevifolius*. Indeed, all of the specimens of *C. brevifolioides* that we examined, except one, were misidentified as *C. brevifolius;* on one sheet, labelled *C. tenuifolius*, one plant of *C. brevifolioides* was mounted with one of *C. tenuifolius*. It is not at all surprising that New World *C. brevifolioides* has gone unnoticed for so long. In previously available keys to United States *Kyllinga*, *C. brevifolioides*, because of its long creeping rhizomes, runs immediately to *C. brevifolius*. Upon close inspection, however, the many differences between these two species become evident. The inflorescence of *C. brevifolioides* is round in outline, not oval or rectangular as in *C. brevifolius*, and it always consists of but a single head. The scale keels of *C. brevifolioides* are smooth, whereas those of *C. brevifolius* are denticulate. The spikelet of *C. brevifolius* has a maximum length of 3.2 mm and a mean length of 2.5 mm; that of *C. brevifolioides* has a *minimum* length of 3.5 mm. The achenes of the two species are both obovate, but the achene of *C. brevifolius* is 1.3 mm long (maximum) and that of *C. brevifolioides* is 1.5-1.8 mm long. *Cyperus brevifolius* has only a single stamen; *C. brevifolioides* has either 2 or 3.

We cite here all the New World specimens of *C. brevifolioides* that we have seen. Border of dredged sand over tidal marsh, s.e. along Delaware River, Eddington, Bucks Co., Pennsylvania, *Bayard Long 38547*, 24 Sept. 1932 (GH). Centennial Grounds, Philadelphia, Pennsylvania, *I. Burk 17*, 1878 (GH). Moist open field in clay soil, Audubon Nature Center, Greenwich, Fairfield Co., Connecticut, *L. J. Bradley s.n.*, 4 July 1948 (GH); moist open field in clay soil, Audubon Nature Center, Greenwich, Fairfield Co., Connecticut, *L. J. Bradley s.n.* 2 Oct. 1948 (GH). Sand bar along the Potomac River on US Rt. 340, n. of Neersville, Loudon Co., Virginia, *H. E. Ahles and F. James 61766*, 11 Sept. 1965 (NCU, acc. no. 263428; lower specimen only, the upper one being *C. tenuifolius);* fresh tidal marsh of Chikahominy River, below Barrat's Bridge (or Ferry), James City Co., Virginia, *M. L. Fernald and Bayard Long 11266*, 19 Sept. 1939 (NY). Creek bottom, 1.5 miles north of Red Hill on NC 26, then 2.6 miles west on paved road, Mitchell Co., North Carolina, *H. E. Ahles and J. A. Duke 47285*, 23 July 1958

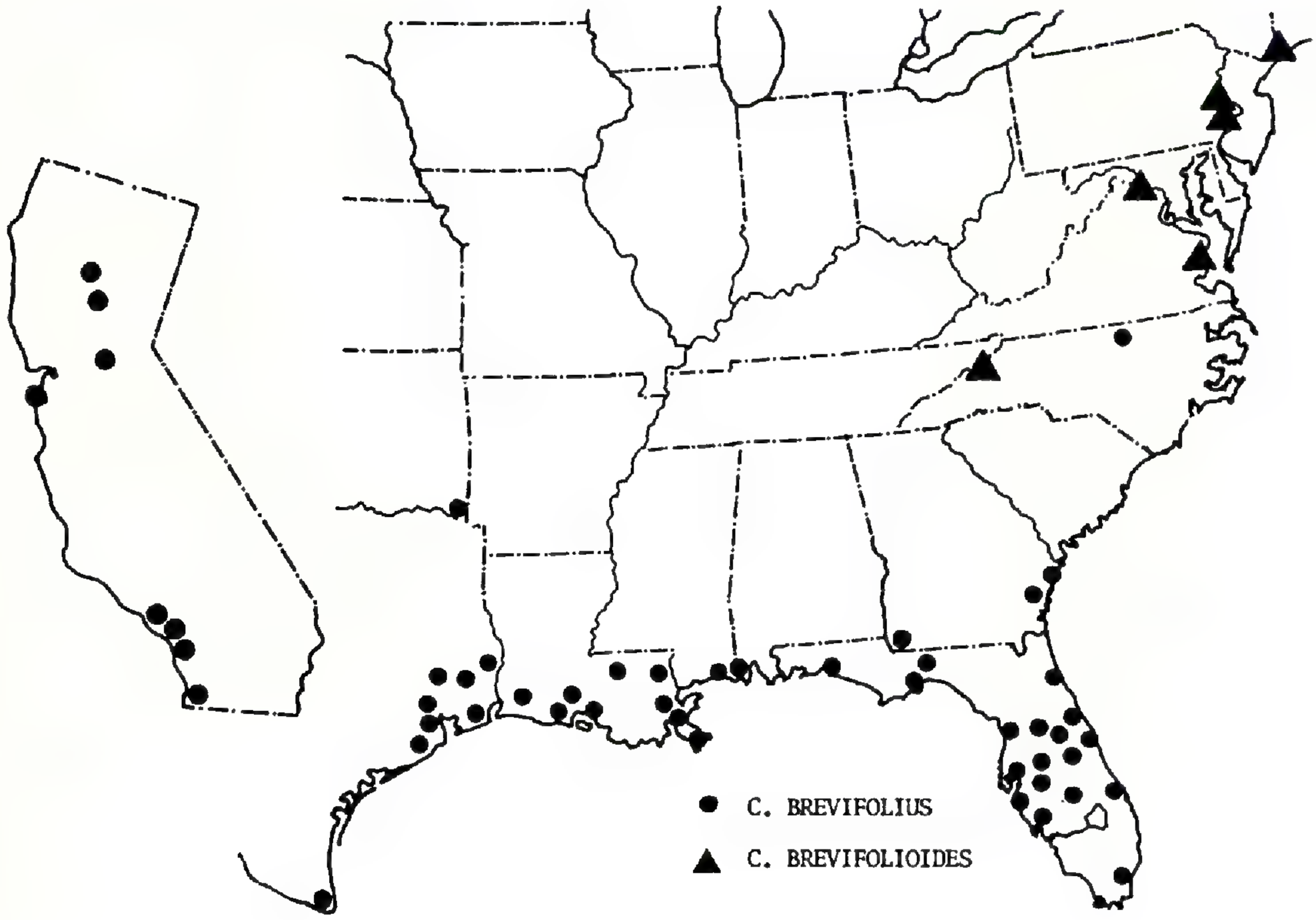
(NCU, acc. no. 136064; duplicate in FLAS, acc. no. 53264); pasture, 1.7 miles northwest of Tipton Hill on road to Huntdale, Mitchell Co., North Carolina, *H. E. Ahles and J. A. Duke 49827,* 25 Sept. 1958 (NCU, acc. no. 136063; duplicate in GH); roadside ditch, Unaka National Forest, near state line, Yancey Co., North Carolina, *E. C. Leonard and G. M. Leonard 16515a,* 17 Oct. 1933 (US).

2. CYPERUS BREVIFOLIUS (Rottb.) Hassk., Catal. Hort. Bogor. 24. 1844.

Kyllinga brevifolia Rottb.

Heads 1-3, 3-8 mm long, 3-7 mm wide; spikelets 2.1-3.2 (mean 2.5) mm long, 0.8-1.2 (mean 0.95) mm wide; scale keels denticulate; achenes 1.0-1.3 (mean 1.14) mm long, 0.6-0.8 (mean 0.72) mm wide, light tan to deep reddish brown, typically broadly obovate but extremely variable (obovate to oblong) even within one head.

Of all the *Kyllinga* specimens we examined we found only one collection (Pasadena, Los Angeles Co., California, *G. L. Skutt s.n.,* May 1935 [CAS, GH, US]) that we were unable to refer to species quickly and with certainty. Of the plants in this collection, some, possessing well developed rhizomes, are typical *C. brevifolius.* Others, however, are, for all practical purposes, cespitose. These cespitose plants possess the wide achene stipe that we regard as an earmark of *C. brevifolius.* Consequently we refer them to *C. brevifolius* even though, in vegetative characteristics, they are quite atypical of that taxon. We consider the



stipe characteristic as one of the best means to distinguish between *C. brevifolius* and *C. tenuifolius*, but it is, unfortunately, one that is difficult to express verbally and to use in a key. The achene of *C. brevifolius* has a broad stipe (ca. 0.15 mm wide); the achene of *C. tenuifolius* has a slender stipe (ca. 0.12 mm wide). This difference in stipe width is a small one but is, in our opinion, a valuable diagnostic feature.

The reports of *C. brevifolius* from Fairfield Co., Connecticut (Bradley, 1949); from "Del. R., Pa." and "Chickahominy R., Va." (Fernald, 1950); and from Mitchell Co., North Carolina (Radford, Ahles, and Bell, 1964) are based upon misidentification of specimens of *C. brevifolioides (q.v.)*.

3. CYPERUS TENUIFOLIUS (Steud.) Dandy, Catal. Vasc. Pl. S. Tomé 363. 1944.

Kyllinga tenuifolia Steud.; *K. pumila* Michx.; *C. densicaespitosus* Mattf. et Kükenth.; *C. densicaespitosus* var. *major* (Nees) Kükenth.

Heads 1-3, 3-7 mm long, 3-6 mm wide; spikelets 1.8-3.3 (mean 2.3) mm long, 0.5-1.1 (mean 0.8) mm. wide; scale keel denticulate but sometimes only slightly so; achene tan at maturity, oblong to oblong truncate, 1.1-1.4 (mean 1.2) mm long, 0.4-0.7 (mean 0.6) mm wide.

This is the most widespread species of *Kyllinga* in continental United States. Some of the *C. tenuifolius* specimens seen by us (e.g., Alabama, *Earle and Baker 1442*, [NY]; Arkansas, *Buchholz 324*, [UARK]; Florida, *Godfrey 55975*, [FSU] are seemingly referrable to var. *major* (Nees) Kükenth., which is described (Kükenthal, 1936) as having spikelets to 3 mm long. In our specimens, some of the spikelets reach 3.3 mm. However, spikelet size in United States *C. tenuifolius* ranges, with an almost unbroken series of intermediates, from 1.8 to 3.3 mm. Consequently, we are unable to recognize var. *major* as a valid taxon.

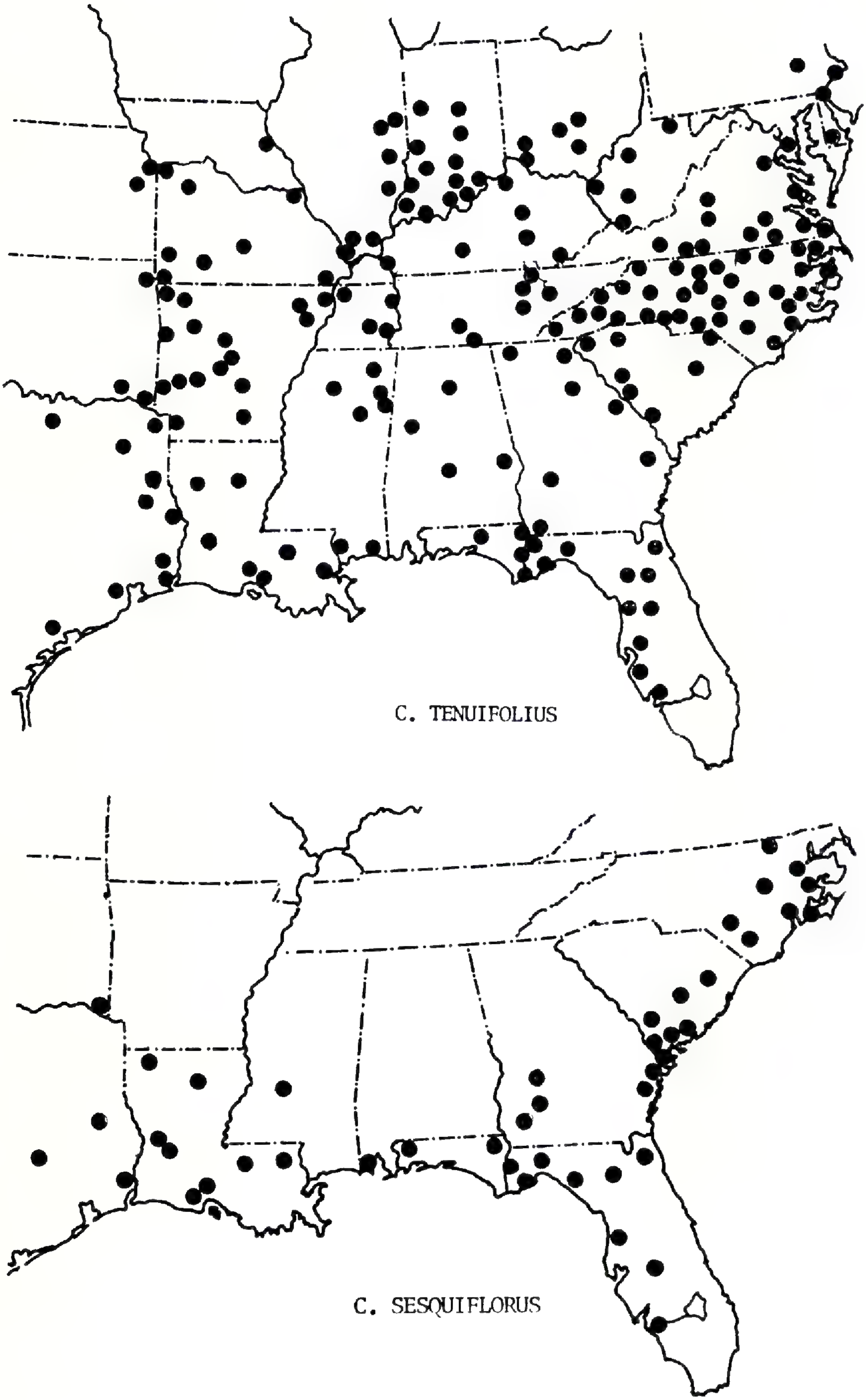
4. CYPERUS SESQUIFLORUS (Torr.) Mattf. et Kükenth., in Kükenth., Cypereae 591. 1936.

Kyllinga sesquiflora Torr.; *K. odorata* Vahl

Heads 1-3, 7-14 mm long, 5-7 mm wide, very light green to whitish; bracts subtending head(s) often strongly reflexed; spikelets 2.4-3.2 (mean 2.8) mm long, 1.1-1.5 (mean 1.3) mm wide, the tips of the scales spreading, not appressed; scale keel sometimes denticulate (in. ca. one-fourth of the specimens examined) but more often smooth; achene 1.2-1.5 (mean 1.4) mm long, 0.8-0.9 (mean 0.83) mm wide, long obovate and usually somewhat angular, rather than smoothly curved, in outline, purple black at maturity but stipe and apiculus pale yellowish white.

Acknowledgements

Specimens of *Cyperus* subgenus *Kyllinga* were borrowed from the following herbaria: CAS, DAO, DUKE, FSU, GH, ILLS, IND, KSC, LE, MICH, NCU, NY, OKL, SMU, UARK, UC, US, and California Department of Agriculture, Sacramento. Our thanks go to the curators of these collections for making the sheets available on loan. The



C. TENUIFOLIUS

C. SESQUIFLORUS

drawings of spikelets and achenes were done by Mr. Billy Dan Hinton; the maps, by Mr. Tony Hebert.

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REVISION OF GUILLEMINEA (BRAYULINEA) INCLUDING GOSSYPIANTHUS (AMARANTHACEAE)

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The correctness of the name *Guilleminea* HBK and the relation of that genus to *Gossypianthus* Hooker have been unclear since the original descriptions. Until the revision of rules of nomenclature in 1939, *Guilleminea* was not clearly correct. Before 1939, there had been a switching of species from *Guilleminea* to *Gossypianthus* and from *Gossypianthus* to *Guilleminea* and *Brayulinea* Small. Thus there is a lengthy synonymy of nearly every species. The species exhibit great variation in macroscopic structures, and forms of one species often look more like certain forms of another species than like each other; in many herbaria the specimens are mislabeled. Examination of the calyx under a good lens is the only way to be sure of the determination.

A study of 335 specimens labeled variously *Guilleminea, Gossypianthus,* and *Brayulinea* has resulted in revisions of *Guilleminea* and *Gossypianthus* and their combination under *Guilleminea* HBK emend. Mears. The discussion included with each taxon described here should explain the nomenclatural and morphological bases for them.

Previously *Guilleminea* has been separated as a monogeneric tribe of the Gomphrenoideae; its combination with *Gossypianthus* places it in the Gomphreneae. A key to the New World genera of the Gomphrenoideae is given after the descriptions.

GUILLEMINEA HBK emend. MEARS

Perennial herbs, rarely becoming woody; stems often procumbent, lanate to nearly glabrous; leaves opposite, extremely variable in size, shape, and pilosity; 3 kinds of leaves on a plant—large radical leaves, fairly large cauline leaves subtending each node, and tiny leaves subtending each spike; radical rosette leaves persisting or withering before anthesis, 10-95 mm. long by 3-15 mm. wide, linear to spathulate or oblanceolate and acute or obtuse; radical leaves rarely without a winged petiole varying in size and usually lacking chlorophyll; cauline leaves 2-30 mm. long by 1-10 mm. wide, linear acute to spathulate or ovate and obtuse; cauline leaves with a wide, winged petiole. Inflorescence a single flower or a spike of 2-30 flowers; spikes often densely aggregated at nodes; each flower sessile with 2 bracts and a bractlet, below which a pedicel (subtended by two tiny leaves) extends to a stem; involucres persistent; flowers hermaphroditic, 5-merous; petals 0; calyx rotate to erect, depending on the amount of rigid sepal tissue in the free calyx

SIDA 3 (3): 137—152. 1967.

segments; calyx covered with silky hairs developing from the rigid sepal tissue; sepals 5, 2 more concave than the other 3, except when the calyx is fused; calyx segments with a sterile membranous fringe varying in area from less than 5% of the sepal in some *G. lanuginosa* to more than 90% of the total calyx lobe area in some *G. densa;* sepals trinerved and often chlorophyllous; 5 filaments united into a tube, either free from the calyx and cuplike around the base of the pistil or adnate to the fused calyx for 75-100% the length of the filament tube; free filament lobes ovate to linear and acute; anthers unilocular; staminodia and pseudostaminodia absent; style 1, usually short, but extended in *G. Brittonii;* stigma capitate and always bilobed. Fruit a membranous, indehiscent capsule; ovary unilocular with a single, apically pendulous ovule; ovule vertical, ovoid, somewhat reniform; endosperm central and farinose; embryo annular peripheral, and with the radicle ascending.

TYPE: *Guilleminea illecebroides* (Willd.) HBK (now included in *Guilleminea densa* (Willd.) Moq.)

Guilleminea HBK was rejected as a valid generic name by Small in 1903 because of the existence of the name *Guilleminea* Necker. The botanical congress of 1939 adopted a ruling which declared Necker's use of uninomials illegitimate; thus *Guilleminea* HBK is valid. The newly combined genus must be called *Guilleminea* because *Gossypianthus* was described 17 years later.

Guilleminea has been separated from *Gossypianthus* primarily because of the adnation of the filament tube to the fused calyx in the former genus; studies of all the published species and varieties of the two taxa support five major conclusions:

1) in both taxa the filaments are always united, but the degree of coalescence is variable;

2) the free filament lobes in *Gossypianthus* often are nearly enclosed by the concavity of the sepals;

3) the degree of coalescence of the calyx is sequentially variable: in *G. australis* the calyx tissue is coalescent slightly below the top of the adnation of the filament tube to the calyx; in *G. densa* var. *densa* the calyx tissue is coalescent at least as high and often higher than the highest filament tube adnation;

4) there is a clear continuity in the proportional decrease in the area of rigid calyx tissue and increase in the area of membranous fringe in the total area of the calyx segments (see Figure 1);

5) although there is only one fairly complete transition between the two taxa, there are other transitions suggested by the macroscopic similarity of certain forms of *Guilleminea* to certain forms of *Gossypianthus.* The simplicity of the one clear transition indicates that such transitions might have occurred more than once.

The range of the genus *Guilleminea* is the southwestern United States,

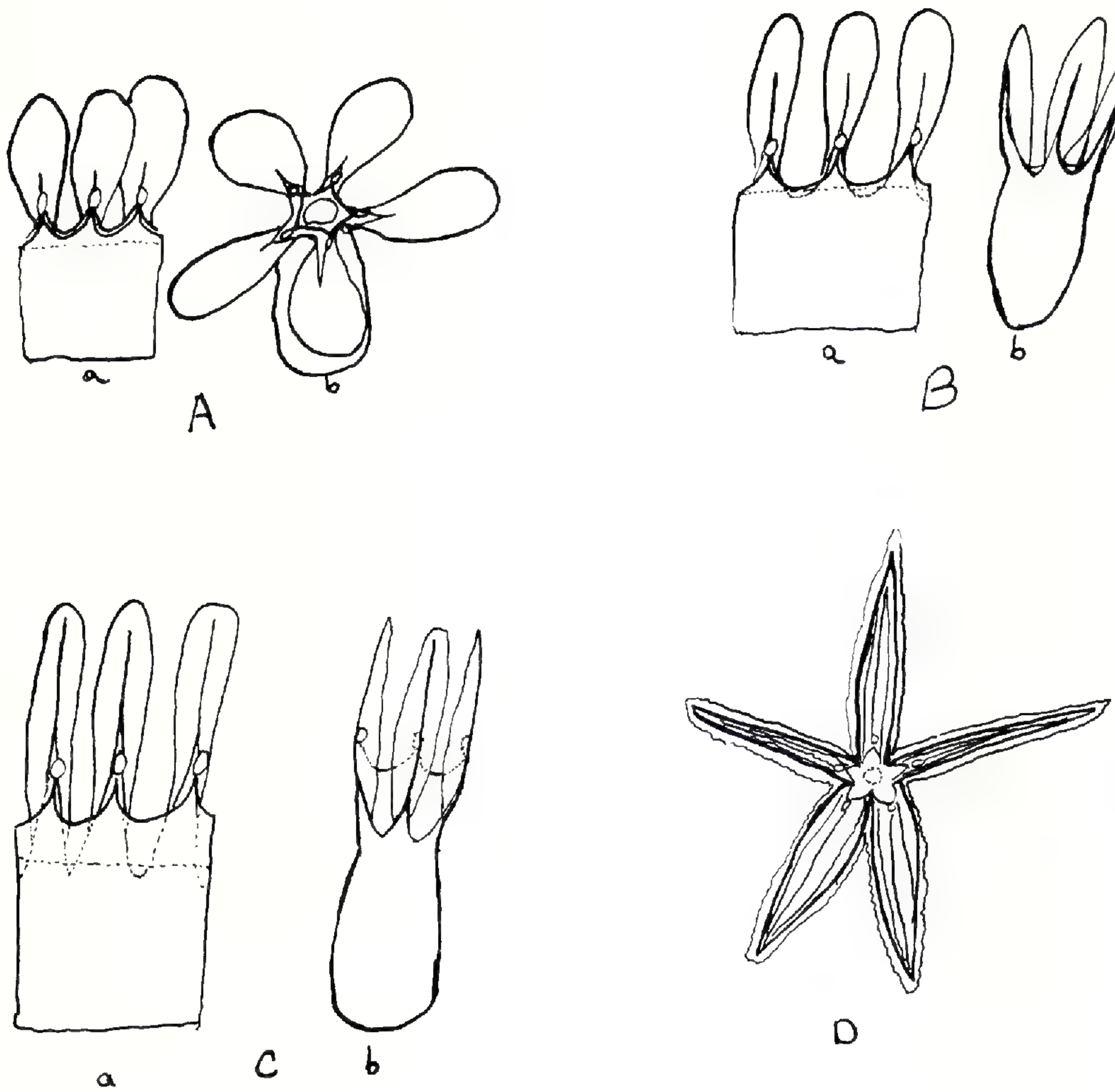


fig. 1

Figure 1. A. *Guilleminea densa* var. *densa*—a, cutaway showing filament tube - calyx relationship, and b, the exterior appearance of the flower. B. *Guilleminea densa* var. *gracilis*—a, cutaway showing filament tube - calyx relationship, and b, the exterior appearance of the flower. C. *Guilleminea australis*—a, cutaway showing filament tube - calyx relationship, and b, the exterior appearance of the flower. D. General appearance of the filament tube and calyx of Subgenus *Gossypianthus* when the flower is forced open.

central to northern Mexico, Haiti, the Dominican Republic, Cuba, and northwestern and north central South America. The ranges of the species and varieties are given with the respective descriptions.

Key to the Subgenera of Guilleminea

1a. Filament tube adnate to the calyx.....I. Subgenus *Guilleminea*
1b. Filament tube free from the calyx.....II. Subgenus *Gossypianthus*

1. Subgenus GUILLEMINEA

Guilleminea HBK in Nov. Gen. et Sp. vi, 40, 518 (1823).

Guilleminia Reichb. Consp. 161 (1828), orthogr. var.

Brayulinea Small in Flora of the SE. U.S., ed. 1, 394 (1903).

Radical leaves present as a winter rosette, but rarely persistent until time of fruiting; filament tube united with the calyx; calyx fused from slightly below to slightly above the top of the filament tube adnation to the calyx.

TYPE SPECIES: *Guilleminea illecebroides* (Willd.) HBK (=*Guilleminea densa* (Willd.) Moq.)

The only way to identify this subgenus is to examine the minute calyx. Several specimens with a persistent radical rosette have been observed; the size and shape of the cauline leaves is just as variable as that of the cauline leaves of the other subgenus. Only within the subgenera can the leaves be used to distinguish taxa.

The subgenus is fairly common from Oklahoma to central Mexico. It has not been observed from Haiti, the Dominican Republic, or Cuba. This subgenus is the only one reported from South America.

Key to the Species of Subgenus Guilleminea

1a. Flowers less than 2.5 mm. long at maturity; calyx rotate or erect 2

2a. Filament tube never more than 0.2 mm. above the level of highest adnation to the calyx; calyx often rotate; sepal nerve less than 2/3 the length of the free calyx lobe, rarely chlorophyllous ..... 1. *G. densa*

2b. Filament tube rising 0.5 mm. above the level of highest adnation to the calyx; calyx erect; calyx lobes with single prominent green nerves extending nearly the length of the calyx lobes ..... 2. *G. australis*

1b. Flowers more than 3.5 mm. long at maturity; calyx rotate; entire filament tube adnate to calyx ..... 3. *G. elongata*

1. GUILLEMINEA DENSA (Willd.) Moq. in DC. Prod. xiii, II, 338 (1849).

Illecebrum densum Willd. in Roem. & Sch. Syst. v. 517 (1819).

Illecebrum alsinaefolium Pavon ex Moq. in DC. Prod. xiii, II, 339 (1849).

Guilleminea illecebroides HBK in Nov. Gen. et Sp. vi, 41 (1823).

Guilleminea Illecebrum Spreng. Syst. iv, Cur. Post., 103 (1825).

Guilleminea densa b. *alsinaefolia* (Pavon) Moq. in DC. Prod. xiii, II, 339 (1849).

Achyranthes conferta Ruiz in Mart. Fl. Bras. v, I, 223 (1840).

Brayulinea densa (Willd.) Small in Fl. SE. U.S., ed. 1, 394 (1903).

Radical leaves 20-25 mm. long by 10-13 mm. wide and lanceolate to spathulate, acute, rarely persisting until fruiting; cauline leaves lanceolate and 3-20 mm. long by 1.5-5 mm. wide; rarely more than 10 flowers grouped into a small capitulum or cylindrical spike; calyx rotate in North American plants and occasionally rotate in South American

specimens; sepals united into a 5-part calyx; each calyx lobe with the central sepal nerve continuing less than 2/3 the length of the free calyx lobe, which is a hyaline membrane except for the sepal nerve; nerve usually without chlorophyll; filament tube barely visible above the level of adnation to the calyx.

Figure 2. DISTRIBUTION OF SUBGENUS GUILLEMINEA. Hollow square, *G. densa* var. *densa;* solid square, *G. densa* var. *humilis;* hollow triangle, *G. densa* var. *aggregata;* solid triangle, *G. australis;* open circle, *G. densa* var. *gracilis;* solid circle, *G. elongata.*

Moquin (1849) described *Guilleminea densa* b. *alsinaefolium* from Pavon's annotation *Illecebrum alsinaefolium.* No locality was given for the variety which was characterized merely as smaller and more fragile than the type variety. Bray and Uline (1895) reduced it to synonymy with var. *densa* without comment. This study has produced no variety which could be distinguished by Moquin's vague description.

A photograph taken in the Berlin Herbarium of the type of *Guilleminea* and a fragment of Mendez' first collection from Mexico were used to determine that both plants are the same. Further comparisons with collections from Mexico and South America verified that the most fragile variety from those areas is the type variety. The photograph of the type was particularly helpful in confirming Moquin's report that the calyxes of the type variety collected in Ecuador are rotate, so that those collections are not the plant from the same area later called *Guilleminea gracilis* Fries.

Collections have been observed from Cimarron Co., Oklahoma, to Oaxaca, Mexico, and from southern Colombia to Cordoba, Argentina. The main areas collected are extreme West Texas, New Mexico, Arizona, and Chihuahua, Mexico, in North America and southern Bolivia to northern Argentina in South America.

Key to the Varieties of Guilleminea densa

1a. Most leaves and flowers produced on ascendent or procumbent stems with obvious internodes 2
2a. Leaves and flowers not densely aggregated at the nodes; mature flowers less than 1.5 mm. long 3
3a. Calyx rotate at maturity; central sepal nerve less than ½ the length of the free lobe ..... var. *densa*
3b. Calyx erect because the rigid sepal nerve extends more than ½ the length of the free lobe; nerve sometimes green. ..... var. *gracilis*
2b. Leaves and flowers densely aggregated at nodes on the thick stems; flowers 1.8-2.2 mm. long at maturity ..... var. *aggregata*
1b. Leaves and flowers completely covering a thick, spreading, horizontal area; stems rarely visible. ..... var. *humilis*

GUILLEMINEA DENSA var. DENSA

Cauline leaves 3-20 mm. long by 5-12 mm. wide and ovate to spathulate, acute or obtuse; inflorescence usually 5-10 flowers in a spiralled, cylindrical spike; flowers less than 1.5 mm. long at maturity of fruit; calyx rotate at maturity; sepal lobes almost entirely membranous, with the central colorless nerve continuing less than ½ the length of the free calyx lobe; calyx lobes spathulate.

This variety intergrades with var. *aggregata.* In these determinations the larger size of the flowers and the denser nodes of var. *aggregata* are important. If the specimen was collected early in the flowering season (February to November in northern areas), the nodes of flowers may

be insufficiently developed to permit careful determination. The shape and size of the leaves subtending each node of aggregation are not good characters because both varieties show great variation.

In North America this variety is the most common; it has been collected frequently from Travis Co., Texas, to the Federal District, Mexico. In South America this variety is much rarer than var. *gracilis;* it has been collected in Bolivia and Ecuador.

GUILLEMINEA DENSA var. **humilis** Mears, var. nov.

Planta musciformis; caules ascendentes rari vel nulli; alae petiolares foliorum caulinorum laminas latitudine aequantes.

Plants appearing like pads of moss; stems usually short and hidden by a dense congestion of flowers and leaves in no apparent nodes; petioles of the cauline leaves as wide as the leaves and without chlorophyll.

This variety is closely related to var. *densa;* the flowers are extremely similar. The peculiar growth habit is the chief distinction. This variety is defined from three collections from central Mexico: the holotype, *E. Lyonnet 107* from Pedregal de San Angelo, D.F., August, 1927; and two paratypes, *G. Arséne 8849* from Glacoquemaca, D.F., October 16, 1913, and *J. Mears 208* from Zimapan, Hidalgo, July 4, 1966. The two earlier collections are in NY and the last is at TEX.

GUILLEMINEA DENSA var. **gracilis** (Fries) Mears, comb. nov.

Guilleminea gracilis Fries, Nov. Acta Reg. Soc. Sci. Upsala, ser. 4, 1(#1):153 (1905).

Brayulinea gracilis (Fries) Schinz in Engler & Prantl, Nat. Pfl., ed. 2, 16c:65 (1934).

Inflorescence a capitulum of 3-7 flowers; each flower on a very short pedicel; flowers less than 1.5 mm. long at maturity; calyx erect; calyx lobes usually narrowly spathulate and concave; calyx lobes membranous except for the obvious central sepal nerve often extending more than ¾ the length of the calyx lobe; calyx often not coalescent as high as the top of the adnation of the filament tube to the calyx.

This variety is almost isolated geographically from var. *densa;* although the type locality of var. *densa* is Ecuador, var. *gracilis* is the predominant form of *Guilleminea* found in South America. The general resemblance of the two varieties is great; from Ecuador and Bolivia there are specimens which could be considered intermediates. The length of the calyx nerve and the resulting erectness of the calyx in var. *gracilis* are the main distinctive characters. Because the specimens are so similar and because probable intermediates have been observed, Fries' species is considered a variety of *Guilleminea densa.* As early as 1937 K. Suessenguth recognized a new variety of *G. densa* from Ecuador and Bolivia; he labeled several specimens with a name apparently inedited. This study failed to find any published reference to his variety. Another name for the variety has been used because Suessen-

guth's name would be confused with that of a much more common species of *Guilleminea.*

This is the southernmost variety of *Guilleminea.* It has been observed from Colombia, Peru, Ecuador, and Argentina. The type is from Argentina.

GUILLEMINEA DENSA var. AGGREGATA Uline and Bray in Bot. Gaz. 20:343 (1895).

Plants larger and more robust than var. *densa;* leaves subtending the nodes often very large and ovate; flowers and leaves densely aggregated on thick stems; flowers 1.8-2.2 mm. long at maturity.

There are many intermediates of var. *densa* and var. *aggregata;* they are not geographically separated. Often very robust specimens of var. *densa* are produced, yet they do not have the dense aggregation at the nodes and the larger flowers. The larger size of the cauline leaves of var. *aggregata* is not distinctive. Only when the larger flowers are present with the densely aggregated condition can the specimen be identified clearly as var. *aggregata.*

This variety is centered farther South than var. *densa.* It is fairly common in Jeff Davis Co., Texas, Chihuahua, New Mexico, and Arizona; but it is more frequent in Coahila, Oaxaca, Jalisco, and the Federal District of Mexico.

2. GUILLEMINEA AUSTRALIS (Griseb.) Hooker f. in Benth. & Hook. Gen. iii, 37 (1883).

Gossypianthus australis Griseb. in Goett. Abh., xix, 8 (1874).

Brayulinea australis (Griseb.) Schinz in Engl. & Prantl, Nat. Pfl., ed. 2, 16c: 65 (1934).

Leaves and flowers not densely compacted; cauline leaves 8-10 mm. long by 3-4 mm. wide, lanceolate to ovate and acute; calyx less than 2.5 mm. long at maturity; each calyx lobe with a prominent chlorophyllous nerve almost the full length of the calyx lobe; membranous fringe around the calyx nerve constituting about 60% of the total calyx lobe area; calyx tissue connecting the sepals below the level at which the filament tube is adnate; the filament tube rising about 0.5 mm. above the fused calyx (like a corona).

This species might be considered a variety of *G. densa,* but an insufficient number of specimens have been collected to observe the degree of variation in *G. australis* or the amount of its intergradation with any other taxa. This species exhibits characters showing the relationship of Subgenus *Guilleminea* to Subgenus *Gossypianthus:* 1) the rigid sepal tissue of the calyx lobe constitutes a greater percentage of the free sepal area than in the rest of the Subgenus *Guilleminea* and a lesser percentage than in the Subgenus *Gossypianthus;* 2) the calyx is primarily adnate to the filament tube and secondarily fused as a result of calyx tissue developing across the bridge provided by the filament tissue. These characters demonstrate some continuity between the sub-

genera and provide a basis for studying the relations of the species and varieties.

This species has been collected in Jujuy Province, Argentina, and in western Paraguay. The type is from Argentina.

3. GUILLEMINEA **elongata** Mears, sp. nov.

Folia sessilia, subglabra; folia radicalia 12-16 mm. longa, 4-5 mm. lata, lanceolato-acutata, persistentia; folia caulina 4-5 mm. longa, 2-3 mm. lata, ovata vel lnceolato-acutata; flores 3.5-5.0 mm. longi, hypocrateriformes; laciniae minus quam 1.7 mm. longae.

Leaves sessile and nearly glabrous; radical leaves 12-16 mm. long by 4-5 mm. wide, lanceolate acute, persistent; cauline leaves 4-5 mm. long by 3-4 mm. wide and ovate or lanceolate and acute; 3-7 flowers in axillary capitula; involucre lightly pubescent; flowers 3.5-5.0 mm. long and tubular rotate; calyx lobes less than 1.7 mm. long; nerve of the sepal lobe less than ½ the length of the lobe, without chlorophyll; stamens coalescent into tube completely adnate to the fused calyx; filament lobes partially enclosed by the sepal lobes.

Only one collection of this new species has been seen, yet its characters are so distinct that it could be referred to no other species. The type and only specimen observed is from Tambores, Tacuarembo, Uruguay *(W. G. Herter* 982, 1937 (NY)).

II. Subgenus **Gossypianthus** (Hooker) Mears, comb. nov.

Gossypianthus Hooker, Ic. Pl., iii, t. 251 (1840)

Radical leaves usually persistent until anthesis; calyx erect, composed of 5 free sepals (2 smaller and more concave than the others); each sepal with 3 green nerves (often bleached by sun and rain); filaments united into a basal cup free from the calyx; filaments usually nearly enclosed by the concavity of the sepals.

TYPE: *Gossypianthus rigidiflorus* Hooker, l.c. (= *Guilleminea lanuginosa* var. *rigidiflora* (Hooker) Mears)

Gossypianthus has been combined with *Guilleminea* because there is a continuity of calyx variation, there is a continuity in the variation of the degree of filament tube association with the calyx, and there is considerable difficulty in distinguishing the subgenera without a lens. This subgenus occurs from Oklahoma to southern Tamaulipas and in Cuba, Haiti, and the Dominican Republic.

Key to the species of Subgenus Gossypianthus

1a. Stems all originating above ground; style 0.1-0.3 mm. long at maturity of fruit . . . . . 4. *G. lanuginosa*

1b. Basal stems usually below ground; style 0.5-0.8 mm long at maturity of fruit . . . . . 5. *G. Brittonii*

4. GUILLEMINEA LANUGINOSA (Poir.) Hooker f. in Benth. & Hook. Gen. Pl., iii, 37 (1883).

Paronychia lanuginosa Poir. Encyl. Suppl. 4:303 (1816).

Gossypianthus lanuginosus (Poir.) Moq. in DC. Prod. xiii, II, 337 (1849).
Illecebrum lanuginosum Poir. ex Moq. in DC. Prod. xiii, II, 338 (1849).
Illecebrum lanatum Hort. Par. ex Moq. in DC. Prod. xiii, II, 337 (1849).
Celosia piloselloides Poit. ex Moq. in DC. Prod. xiii, II, 338 (1849).
Achyranthes piloselloides Poit. ex Moq. in DC. Prod. xiii, II, 338 (1849).

All fertile stems originating above ground; stems rarely flexuous, often procumbent but sometimes ascendent; radical leaves 10-90 mm. long by 3-10 mm. wide, lanceolate to spathulate, acute or obtuse; radical leaves with a widely winged petiole without chlorophyll; inflorescence a small spike or capitulum of 6-12 flowers, axillary; erect calyx with lanate lobes, fringed with a sterile persistent membrane accounting for less than 10% of the total calyx area; sepals trinerved; filaments free; style no more than 0.3 mm. long.

After Moquin described *Gossypianthus lanuginosus* in 1849, there were efforts to combine Hooker's two species with Moquin's. On the published advice of S. Watson (1883) and J. Torrey (1859), who both admitted no examination of Hooker's species *tenuiflorus*, Bray and Uline (1895) published the combination. It was their opinion that Hooker's species *rigidiflorus* showed so much variation in pilosity and leaf size and shape that all the described specimens could come under that description. Without modifying the description, they called all the specimens *G. lanuginosus*.

Moquin recognized all three species in 1849; but since 1895 Hooker's species has been distinguished generally from *G. lanuginosus* without a published precedent. Hooker's species *rigidiflorus* has been assumed synonymous with *G. lanuginosus* (but not by Standley in *North American Flora)*. The following are the results of the study of the complex:

1) this complex is best described as one variable species with four distinct varieties;

2) most of the plants of Oklahoma, Texas, and Mexico differ from Moquin's species and correspond with Hooker's two descriptions.

The name *Guilleminea lanuginosa* is attributed to Hooker f. because he referred both *Gossypianthus australis* Griseb. and *Gossypianthus lanuginosus* (Poir.) Moq. to *Guilleminea* in 1883. However there was no effort to combine the genera, for he retained his father's two species in *Gossypianthus*.

Specimens of this species have been collected from Arkansas and Oklahoma to Tamaulipas and Nuevo Leon and from Haiti and the Dominican Republic.

Key to the Varieties of Guilleminea lanuginosa

1a. Plant not densely pilose; radical leaves usually 20-90 mm. long by

3-6 mm. wide, lanceolate to linear, acute 2
2a. Longest radical leaves 15-25 mm. long; plants low, stems procumbent; cauline leaves often pilose, 5-8 mm. long by 3-4 mm. wide. . . . . var. *lanuginosa*
2b. Longest radical leaves usually 40-90 mm. long, often linear; plants large, often with ascendent stems; plants often nearly glabrous. . . . . var. *tenuiflora*
1b. Plant usually densely pilose with long silky hairs; radical leaves usually 20-80 mm. long by 5-15 mm. wide, oblanceolate and acute to spathulate and obtuse. 3
3a. All leaves very large; radical leaves 30-85 mm. long by 6-12 mm. wide, oblanceolate; cauline leaves 15-20 mm. long by 8-10 mm. wide, spathulate to ovate; leaves densely aggregated on thick stems . . . . . var. *Sheldoni*
3b. Some cauline leaves small, 7-12 mm. long by 3-10 mm. wide; radical leaves 16-60 mm. long by 5-10 mm. wide, spathulate to oblanceolate; leaves not densely aggregated as in above. . . . . var. *rigidiflora*

GUILLEMINEA LANUGINOSA var LANUGINOSA.

Plant rarely larger than 10 cm. high; radical leaves 10-25 mm. long by 4-6 mm. wide, lanceolate to oblanceolate and acute; stems sometimes flexuous, sometimes ascendent; cauline leaves 5-8 mm. long by 3-4 mm. wide.

This variety has been collected rarely in North America; the specimens so commonly labeled this variety are usually var. *rigidiflora*. Where the two varieties concur there is intergradation. This variety has been observed from extreme southern Texas, Tamaulipas, Haiti, and the Dominican Republic. The type is from Haiti, and this variety is the only one collected from Haiti and the Dominican Republic.

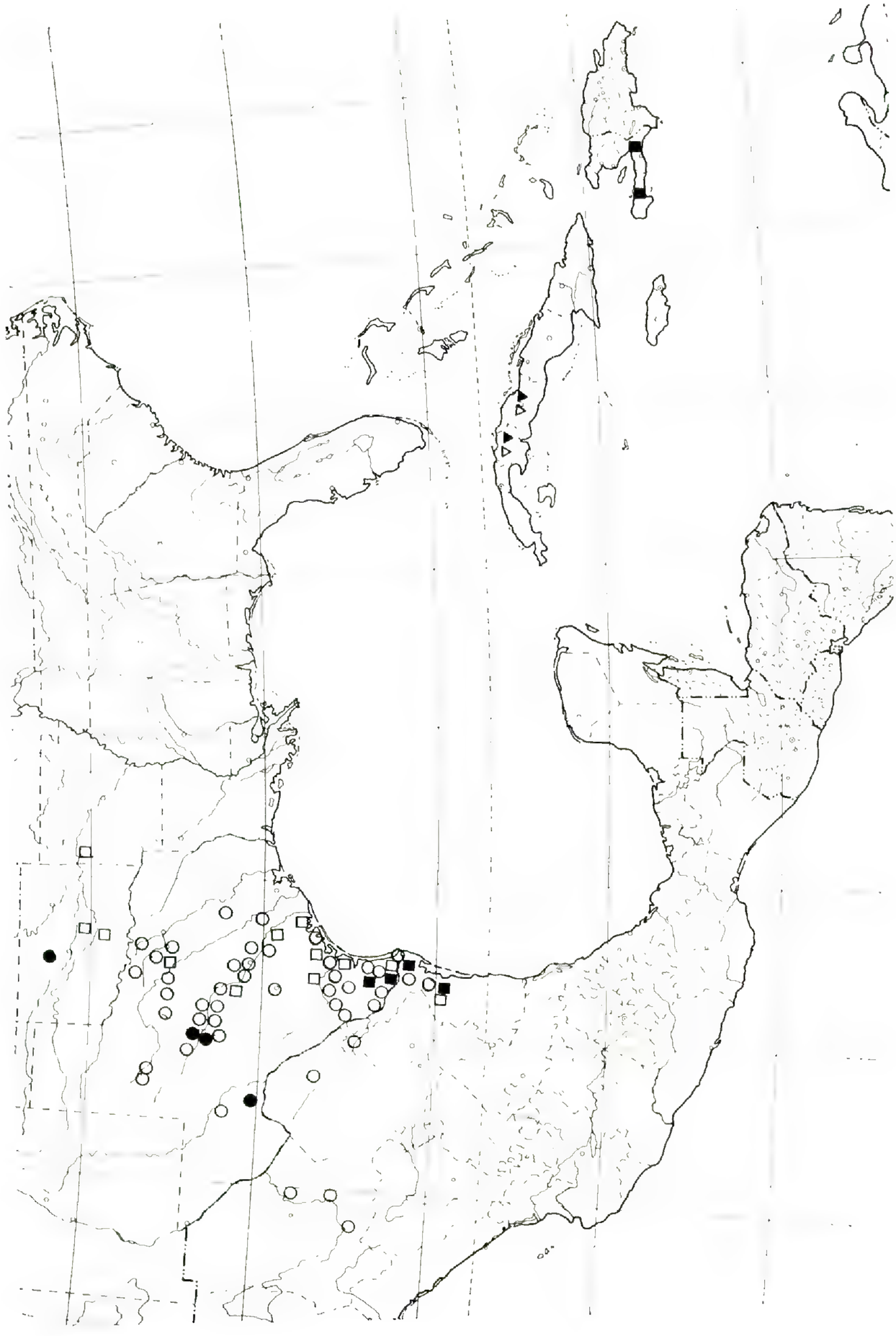
GUILLEMINEA LANUGINOSA var. **tenuiflora** (Hooker) Mears, comb. nov.

Gossypianthus tenuiflorus Hooker, Ic. Pl., iii, t. 251 (1840).

Radical leaves 30-90 mm. long by 3-6 mm. wide, linear to lanceolate, acute; cauline leaves 8-18 mm. long by 4-6 mm. wide, lanceolate to oblanceolate, acute; leaves nearly glabrous at anthesis; nodes of inflorescences farther apart than in other varieties; marginal membranes on sepals somewhat wider than those of var. *lanuginosa*.

If good representatives of this taxon had been observed by Watson, Torrey, and Uline and Bray, they probably would not have reduced it to synonymy with *G. lanuginosa*. Much was written about the shape of bracts and the dilation of filament lobes; Uline and Bray perceptively disputed the use of such variables, but they neglected to note the differences in habit and general appearance which distinguish this variety.

This variety occurs in the North-South progression of the Blackland Prairies of Oklahoma and Texas, the Post Oak Savannah, and the Gulf



Prairies of Texas. It has been collected no farther West than Llano Co., Texas, and only rarely in Arkansas and Tamaulipas, Mexico.

GUILLEMINEA LANUGINOSA var. **rigidiflora** (Hooker) Mears, comb. nov.

Gossypianthus rigidiflorus Hooker, Ic. Pl., iii, t. 251 (1840).

Plants larger and more robust than those of the type variety; stems thick, never flexuous; stems and leaves usually densely pilose but rarely worn to glabrosity by rain and wind; radical leaves 16-60 mm. long by 4-10 mm. wide, oblanceolate and barely acute to spathulate and obtuse; cauline leaves 7-18 mm. long by 3-13 mm. wide, lanceolate, acute to ovate; marginal membrane on sepals wider than in var. *lanuginosa.*

Variety *rigidiflora* is the most common; it seems to be intermediate between var. *Sheldoni* and var. *lanuginosa.* Yet, this variety occurs where the other two do not occur. It has been collected as far west as Pecos, Texas, and southwestern Chihuahua, Mexico; it has been collected as far north as Sapulpa, Oklahoma, and as far south as central Tamaulipas, Mexico. This variety generally connects and intergrades with all the other varieties of *G. lanuginosa.*

GUILLEMINEA LANUGINOSA var. **Sheldoni** (Uline & Bray) Mears, comb. nov.

Gossypianthus lanuginosus var. *Sheldoni* Uline & Bray Bot. Gaz. 20:342 (1895).

Gossypianthus Sheldoni (Uline & Bray) Small in Fl. SE. U.S. p. 394 (1903).

Radical leaves 30-84 mm. long by 6-12 mm. wide, lanceolate to oblanceolate; cauline leaves 15-20 mm. long by 8-10 mm. wide, ovate and acute to obovate and obtuse; leaves densely tomentose; stems thicker than in the other varieties of *G. lanuginosa.*

Many specimens labeled var. *Sheldoni* are var. *rigidiflora;* the former variety is very rare. Perhaps var. *Sheldoni* is an extremely large form of var. *rigidiflora* (in which case the combined variety should be called var. *Sheldoni);* but var. *Sheldoni* is distinctly larger than var. *rigidflora* and occurs only in the extreme western limits of the latter's range. Small's observation that the sepals are nerveless or without chlorophyll is without basis. The type specimen does have three chlorophyllous nerves in each sepal; however many of the flowers are basal, old, and bleached by the weather. This variety has been collected along a line from Major Co., Oklahoma, through Taylor Co., Texas, to Terrell Co., Texas.

Figure 3. DISTRIBUTION OF SUBGENUS GOSSYPIANTHUS. Hollow square, *G. lanuginosa* var. *tenuiflora;* solid square, *G. lanuginosa* var. *lanuginosa;* open circle, *G. lanuginosa* var. *rigidiflora;* solid circle, *G. lanuginosa* var. *Sheldoni;* hollow triangle, *G. Brittonii* var. *Brittonii;* solid triangle, *G. Brittonii* var. *heterophylla.*

GUILLEMINEA **Brittonii** (Standley) Mears, comb. nov.

Gossypianthus Brittonii Standley in Contrib. U.S. Nat. Herb., xviii, 92 (1916).

Plants nearly glabrous, very small, usually less than 10 cm. extended; most of the supporting stems originating below ground; stems less than 1 mm. thick, flexuous; radical leaves 5-20 mm. long by 1-5 mm. wide, oblanceolate acute to obtuse; radical leaf petioles broadly winged or bare; flowers 5-30 in somewhat cylindrical spike-like racemes; each flower pedicellate; membranous part of the sepal up to 20% of the sepal area; style 0.5-0.9 mm. long at maturity.

Standley named this species in 1916 and subsequently referred all Cuban specimens to it. He personally labeled several specimens which correspond to *Gossypianthus heterophyllus* Ekman & Suessenguth; Ekman and Suessenguth described another species, *Jackianus*, in 1934 from specimens which correspond to Standley's species. Here *G. heterophyllus* is considered a variety of *G. Brittonii*.

Key to the Varieties of Guilleminea Brittonii

1a. Radical leaves with a widely winged petiole void of chlorophyll; style 0.6-0.9 mm. long; flowers in cylindrical spike-like racemes of 10-30. . . . . var. *Brittonii*

1b. Radical leaves with an unwinged petiole; style about 0.5 mm. long; flowers in short capitula of 3-8. . . . . var. *heterophylla*

GUILLEMINEA BRITTONII var. BRITTONII.

Gossypianthus Jackianus Ekman & Suesseng. Rep. Spec. Nov. 35:317 (1934)

Radical leaves 5-7 mm. long by 1-2 mm. wide, spathulate to lanceolate, with a long, widely winged petiole; cauline leaves 3-6 mm. long by 1-4 mm. wide, ovate, with a very broadly winged petiole; stems 5-10 cm. long; flowers in cylindrical spikes of 10-30; style very long, usually 0.7-0.9 mm. long.

This variety has been collected only in Las Villas and Mantanzas Provinces of central Cuba. It is larger at maturity than the other variety. *Gossypianthus Jackianus* was described from an extremely poor specimen; the arid environment probably accounts for the few minute differences between the type of *G. Jackianus* and var. *Brittonii*.

GUILLEMINEA BRITTONII var. **heterophylla** (Ekman & Suesseng.) Mears, comb. nov.

Gossypianthus heterophyllus Ekman & Suesseng. Rep. Spec. Nov. 35:317 (1934).

Plants very small, less than 5 cm. high; leaves slightly pilose; radical leaves 8-20 mm. long by 3-5 mm. wide, lanceolate to oblanceolate; radical petiole not winged; cauline leaves 5-7 mm. long by 3-4 mm. wide, ovate and acute; flowers in capitula of 3-8 flowers; style about 0.5 mm. long, shorter than that of var. *Brittonii* but longer than that of any specimen of *G. lanuginosa* examined.

The floral characters of this variety are very similar to those of the type variety. Only the slight difference in style length is noticeable; Suessenguth mentioned the pilosity of the bracts as a key distinction in *G. heterophyllus*, but an isotype labeled by Suessenguth shows that the pilosity develops either between the bracts and the sepals or on the rigid sepal tissue.

This variety has been collected only from Las Villas and Mantanzas Provinces of central Cuba.

EXCLUDED SPECIES

Gossypianthus decipiens Kuntze Rev. Gen. p. 543 (1891) = Hebanthe decipiens Hooker f.

G. guianensis Kuntze, l.c. = Hebanthe guianensis Klotzsch

G. Hookerianus Kuntze, l.c. = Hebanthe Hookerianus Hemsley

G. mollis Kuntze, l.c. = Hebanthe mollis Hemsley

G. subnudus Kuntze, l.c. = Hebanthe subnudus Hemsley

G. tomentosus Griseb. Goett. Abh, xxiv, 35 (1879) = Gomphrena tomentosa (Griseb.) Fries

Key to New World Genera of Gomphrenoideae

It is useful to give here a key to the genera of the Gomphrenoideae of the Amaranthaceae in the New World, including the newly emended genus *Guilleminea*. It had previously been separated in the monogeneric Guillemineae or Brayulineae because of the coalescent calyx. Since the coalescence has been described as a development of filament tube extension and filament lobe enclosure by the calyx lobes, *Guilleminea* should be a member of the tribe Gomphreneae of the Gomphrenoideae.

1a. Stamen 1; flowers 4-merous. . . . . *Woehleria*
1b. Stamens 2-5; flowers 5-merous. 2
  2a. Most of the flowers unisexual. 3
    3a. Leaves opposite. . . . . *Iresine*
    3b. Leaves alternate. . . . . *Dicraurus*
  2b. Few, if any, flowers unisexual. 4
    4a. Style 1 or 0; stigma 1 and capitate, penicillate, or bilobed (not subulate) 5
      5a. Stigmatic surface penicillate. . . . . *Froelichiella*
      5b. Stigmatic surface not penicillate 6
        6a. Inflorescences mostly axillary. 7
          7a. Perianth unequal or calyx united. 8
            8a. Filament tube a short cup or adnate to the fused calyx. . . . . *Guilleminea*
            8b. Filament tube longer than ovary and free from the calyx. 9
              9a. Style short or none. . . . . *Alternanthera*
              9b. Style long. . . . . *Telanthera*
          7b. Perianth equal; style long; sepals free. . . *Mogiphanes*
        6b. Inflorescences mostly terminal. 10

10a. Pseudostaminodia 0. . . . . *Froelichia*
10b. Pseudostaminodia present. 11
11a. Leaves clearly petioled. . . . . *Hebanthe*
11b. Leaves sessile or subsessile. . . . . *Pfaffia*
4b. Stigmas 2 or 3; styles 1 or 2. 12
12a. Filaments united into a short cup. 13
13a. Flowers stipitate; inflorescence spicate. . . . *Philoxerus*
13b. Flowers sessile; inflorescence a single flower. . . . . *Tidestromia*
12b. Staminal tube long. 14
14a. Herbaceous plant. . . . . *Gomphrena*
14b. Woody shrub. . . . . *Pseudogomphrena*

The lack of distinguishing characters in the type descriptions of *Mogiphanes* and *Telanthera*, *Hebanthe* and *Pfaffia*, and *Gomphrena* and *Pseudogomphrena* suggest necessary work in descriptions and/or revisions.

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The continuous conscientious advice and guidance of Dr. M. C. Johnston of the University of Texas botany faculty has made this paper possible; the concurrent advice and explanations of Robert Irving, Imre Eifert, Dr. Will Blackwell, and Dr. John Strother of the botany staff and graduate school have contributed greatly. I am grateful particularly to Dr. Lloyd Shinners of the Herbarium of Southern Methodist University for the extensive and invaluable comments and suggestions which have made this paper presentable. In addition I wish to thank Dr. Luciano Bernardi of the Botanical Gardens of Geneva for his collaboration in supplying information about type material.

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CHROMOSOME NUMBERS IN SOME SOLANACEAE

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Recently I have had an opportunity to work on cytological material of several species of Solanaceae for which chromosome counts have not been reported. These are listed in Table 1 along with substantiating counts for some other species. In the case of *Solanum*, the respective section to which each species belongs is indicated in parenthesis. All reports are based upon at least two counts.

Buds were obtained from plants collected in the field (Florida, Mexico and South America) and both root-tips and buds from plants grown in the greenhouse. Meiotic figures were prepared with 1% aceto-carmine from buds fixed in Farmer's fixative. For root-tip smears the lacto-propionic orcein procedure used by Kawano (1965) was employed. The 2, 4 Dinitrophenol was omitted from Östergren and Heneen's fixative as these workers suggested (1962). The gametic and/or somatic number is reported depending upon the material(s) available and the method(s) employed. Voucher specimens of all plants have been deposited at the University of Wisconsin Herbarium, and duplicates of many will soon be distributed to other herbaria.

I am grateful to Dr. Shoichi Kawano for his generous instruction in cytological technique and to Dr. Hugh H. Iltis for providing much of the material used in this study. This work was done while supported by a predoctoral fellowship from the National Institutes of Health. Cytological material from Peru and Ecuador was collected in conjunction with research on tuberous *Solanum* species supported by a grant to H. H. Iltis from the National Science Foundation.

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Table 1. Chromosome numbers in some Solanaceae

Solanum	*n*	*2n*	*Collector and/or source of material*
(Brevantherum) abutiloides (Griseb.) Bitt. & Lillio		24	seed from Argentina
(Lycianthes) acutifolium R. & P.		24	*Iltis, et. al. 735*, Curahuasi, Dept. Apurimac, Peru
(Torvaria) asperolanatum R. & P.	12	24	*Iltis, et. al. 215*, 5 km below Tarma, Dept. Junin, Peru
(Micracantha) bahamense L.	12		*Roe 118*, Long Key, Florida
(Micracantha) blodgettii Chapm.	12		*Roe 119*, Big Pine Key, Florida
(Asterotrichotum) crinitipes Dunal		24	*Iltis 1624*, Quito, Ecuador
(Brevantherum) erianthum D. Don	12		*Roe 91*, Dade Co., Florida
(Brevantherum) hazenii Britton	12		*Mick & Roe 326*, Isthmus of Tehuantepec, Edo. Oaxaca, Mexico
(Micracantha) hirtum Vahl	12		seed from Trinidad
(Jasminosolanum) macrantherum Dunal		24	*Roe & Roe 1940*, 5 km N Ixtapan, Edo. Mexico, Mexico
(Asterotrichotum) mitlense Dunal		24	*Roe & Roe 1908a*, 2 km N Ixtapan, Edo. Mexico, Mexico

(Solanum syn. Morella) nodiflorum Jacq.		24	*Iltis, et. al. 388*, Lima, Peru
(Indubitaria) nutans R. & P.		24	*Iltis & Ugent 650b*, NNW Abancay, Dept. Apurimac, Peru
(Solanum syn. *Morella) pallidum* Rusby	12		*Iltis & Ugent 779*, Ancahuasi, Dept. Cuzco, Peru
(Melongena) quitoense Lam.		24	Seed from Guayaquil, Ecuador
(Jasminosolanum) radicans L. f.		24	*Iltis, et. al. 734*, Curahuasi, Dept. Apurimac, Peru
(Torvaria) saponaceum Dunal	24	48	*Iltis, et. al. 834*, 33 km SW Abancay, Dept. Apurimac, Peru
(Jasminosolanum) seaforthianum Andr.	12		*Roe 126*, cultivated, Ft. Lauderdale, Florida
(Micracantha) stramonifolium Jacq.	12		Seed from Trinidad
(Torvaria) torvum Sw.		24	Seed from Cerro San Felipe, Edo. Oaxaca, Mexico
(Brevantherum) umbellatum Mill.		24	*Roe, Roe & Mori 1356*, 36 km S. Dzuiche, Q. Roo, Mexico
(Micracanthes) wendlandii Hook. f.		24	*Roe 129*, cultivated, Ft. Lauderdale, Florida
Cyphomandra betacea Sendtn.	12	24	Seed from Urubamba, Peru
Cestrum flavescens Greenman	8		*Iltis & Iltis 1689*, 2 km SSW La Cima, D. F., Mexico
Saracha herrerae Morton	12		*Iltis, et. al. 972*, 9 km SW Pisac, Dept. Cuzco, Peru

CHROMOSOME NUMBERS OF CHAMAESARACHA (SOLANACEAE) IN TRANS-PECOS TEXAS AND ADJACENT REGIONS[1]

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The genus *Chamaesaracha* is comprised of 13 species, of which 5 occur in Asia, 1 in South America, and 7 in North America. According to Gould (1962) only 2 species, *C. coronopus* and *C. sordida*, inhabit Texas. However, *C. crenata* was reported by Rydberg (1896) to occur in Texas along the Rio Grande and New Mexico, and we have confirmed this (Table I). More recently, Scudday (1965) has verified the occurrence of another predominantly Mexican species, *C. villosa*, in west Texas.

The data presented here have originated both as a part of an overall project for reporting chromosome numbers of Trans-Pecos species, and from an earlier observation that populational entities of *Chamaesaracha* in this region exhibit considerable morphological variation. The junior author currently is pursuing a systematic study of the taxa in question using chromatographic as well as cytological data; therefore, answers to many questions raised here will be forthcoming.

METHODS AND TECHNIQUES

Buds were collected in the field and fixed in Modified Carnoy's Solution. Techniques for observation of meiotic chromosomes follow those outlined by Turner and Johnston (1961). Mitotic preparations were made according to methods employed by Turner and Fearing (1959). Staining of meiotic and mitotic chromosomes was accomplished with acetocarmine.

It should be noted that the most reliable counts were determined from anaphase I stages, or diads, because chromosomes were usually clumped and "sticky" at diakinesis and metaphase I in most *Chamaesaracha* individuals examined (Figs. 1, 3-7). Exceptionally, with chromosome numbers of $n = 12$, configurations were fairly clear at diakinesis and metaphase I. Meiosis was apparently regular in all plants (with one exception, see below), or at least there were an equal number of chromosomes segregating to each pole.

All chromosome numbers reported here are meiotic, with the exception of *Averett and Powell 65*, and *Averett 71* (Table I), but several polyploid individuals have been checked by mitotic examinations. So far seed germination of diploid plants ($n = 12$) has proved difficult.

Voucher specimens have been deposited in the herbaria at Sul Ross State College and The University of Texas, Austin.

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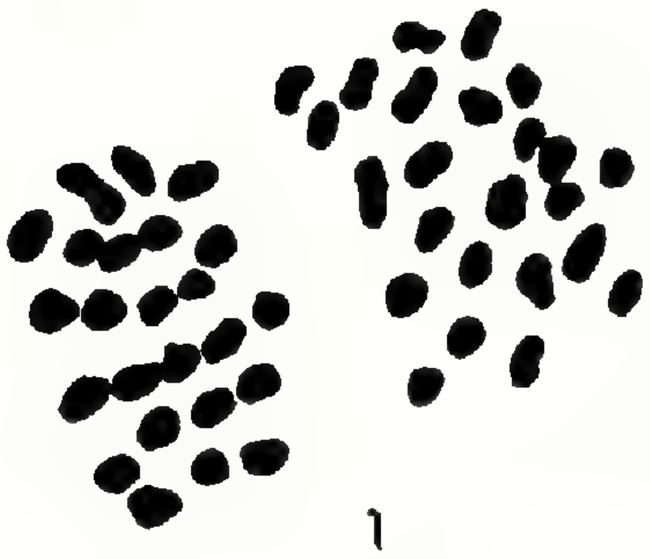
[1] Aided in part by National Science Foundation Grants GB-2400 and GB-5046.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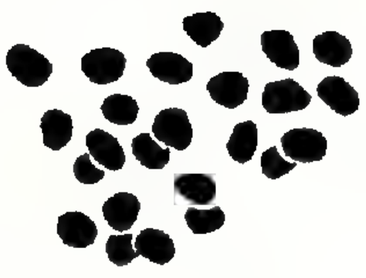
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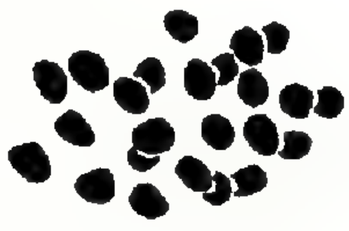

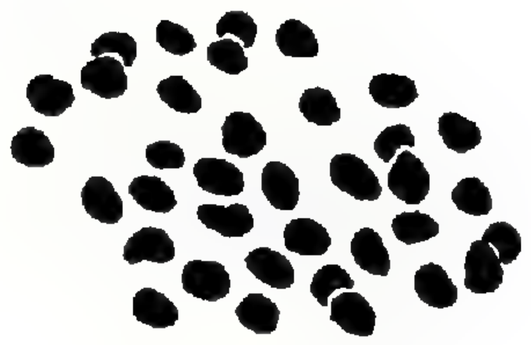
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Figs. 1-7. Meiotic (anaphase I) and mitotic chromosomes of *Chamaesaracha* species, all X ca. 1300. Fig. 1. *C. coronopus (Sikes 61a; n = 24).* Fig. 2. *C. sordida (Averett 71; 2n = 48).* Fig. 3. C. cf. *sordida (Averett & Watson 162; n = 12).* Fig. 4. *C. sordida (Averett & Watson 161; n = 24).* Fig. 5. *C.* cf. *sordida (Averett 155; n = 36).* Fig. 6. *C. villosa (Sikes 59; n = 12).* Fig. 7. *C. crenata (Averett & Watson 66; n = 12.*

Table I. Species of *Chamaesaracha* examined for chromosome number.

Species	*n number*	*location and voucher*
C. coronopus	24	TEXAS: Brewster Co. Sul Ross Campus, Alpine. *Averett 69.*
	24	TEXAS: Brewster Co. Sul Ross Campus, Alpine. *Averett 132.*
	24	TEXAS: Brewster Co. Sul Ross Campus, Alpine. *Watson 48.*
	24	TEXAS: Culberson Co. 42 mi n. of Van Horn. *Sikes 75.*

	24a	TEXAS: El Paso Co. 1 mi. e. of Franklin Mts. *Sikes 61a, b.*
	24	TEXAS: Jeff Davis Co. 1 mi s.w. of Ft. Davis. *Averett 98.*
	24	TEXAS: Presidio Co. 4 mi. s. of Marfa. *Averett & Sikes 128.*
	24	TEXAS: Presidio Co. 15 mi. s. of Marfa. *Averett 77.*
C. sordida	24a, b	TEXAS: Brewster Co. Sul Ross Campus. *Averett 71.*
	24	TEXAS: Brewster Co. 6 mi s. of Alpine. *Averett 125.*
	24	TEXAS: Brewster Co. 16 mi e. of Alpine. *Averett 83.*
C. sordida	24	TEXAS: Brewster Co. 6 mi w. of Alpine. *Averett & Sikes 130.*
	24	TEXAS: Brewster Co. 20 mi s. of Alpine. *Averett & Johnson 108.*
	ca. 24	TEXAS: Brewster Co. 6 mi n. of Alpine, *Averett 133.*
	24a	TEXAS: Brewster Co. 12 mi e. of Alpine. *Averett & Watson 161.*
	24	TEXAS: Jeff Davis Co. 16 mi n. of Alpine. *Sikes 5.*
	24	TEXAS: Jeff Davis Co. 6 mi s.e. of Ft. Davis. *Averett 75.*
	24	TEXAS: Jeff Davis Co. 4 mi s. of Ft. Davis. *Averett 135.*
	24	TEXAS: Jeff Davis Co. 1 mi w. of Ft. Davis. *Averett 136.*
	24	TEXAS: Presidio Co. 16 mi s. of Marfa, *Averett 79.*
	24	TEXAS: Presidio Co. 4 mi s. of Marfa. *Averett & Sikes 128.*
	24	TEXAS: Presidio Co. 20 mi n. of Shafter. *Averett 72.*
	24	TEXAS: Presidio Co. Casa Piedra road, 11 mi s. of Marfa. *Averett 149.*
	24	MEXICO: Coahuila. Sierra del Burro Pass. *Powell 1441.*
	24	MEXICO: Coahuila. 24 mi w. of Cd. Acuña. *Powell 1412.*

a Denotes chromosome drawing.

b Derived from root tip cells.

C. cf. sordida	12	TEXAS: Brewster Co. 1 mi w. of Alpine. *Averett & Johnson 114.*
	12	TEXAS: Brewster Co. 5 mi s. of Marathon. *Averett 76.*
	12	TEXAS: Brewster Co. 42 mi e. of Alpine. *Averett 82.*
	12	TEXAS: Brewster Co. 1 mi s. of Alpine. *Averett 112.*
	12a	TEXAS: Brewster Co. Marathon e. city limits. *Averett & Watson 162.*
	12	TEXAS: Brewster Co. Sul Ross Campus, Alpine. *Averett 231.*
	12	TEXAS: Crane Co. 6 mi n. of Imperial. *Averett 80.*
	12	TEXAS: Presidio Co. 35 m s.w. of Marfa. *Averett 153.*
	12	NEW MEX: Chaves Co. 50 mi s. e. of Cloudcroft. *Sikes 72.*
	12	NEW MEX: Chaves Co. 43 mi s. e. of Cloudcroft. *Sikes 70a.*
	12	NEW MEX: Dona Ana Co. 5 mi e. of Las Cruces. *Sikes 66.*
	12	NEW MEX: Dona Ana Co. Foothills on w. side of Organ Mts. *Sikes 63b.*
	12	MEXICO: Chihuahua. 17 km. w. of Sueco. *Powell 1341.*
C. cf. sordida	18	TEXAS: Culberson Co. 21 mi s.w. of Whites City, New Mex. *Sikes 74.*
C. cf. sordida	24	TEXAS: Brewster Co. 25 mi s. of Marathon. *Averett & Watson 163.*
	24	TEXAS: Val Verde Co. 2.5 mi e. of Langtry. *Averett & Watson 86.*
	24	TEXAS: Val Verde Co. 7 mi e. of Langtry. *Averett & Watson 87.*
	24b	TEXAS: Val Verde Co. 8 mi w. of Comstock. *Averett & Powell 65.*
C. cf. sordida	36	TEXAS: Brewster Co. 4 mi n. of Black Gap Hdqs. *Averett & Watson 178.*
	36	TEXAS: Brewster Co. n. e. entrance to Big Bend Nat'l. Park. *Averett & Watson 169.*
	36	TEXAS: Brewster Co. Black Gap road, 9 mi s. e. of US 385. *Averett & Watson 168.*

	36	TEXAS: Pecos Co. 3 mi s. of Imperial. *Averett 182.*
	36	TEXAS: Pecos Co. 5 mi s. of Imperial. *Averett 183b.*
	ca. 36	TEXAS: Pecos Co. 5 mi s. of Imperial. *Averett 183a.*
	36a	TEXAS: Presidio Co. 35 mi s. w. of Marfa. *Averett 155.*
C. villosa	12a	TEXAS: Culberson Co. 4 mi w. of Van Horn. *Sikes 59.*
	12	TEXAS: Hudspeth Co. 20 mi s. of Sierra Blanca. *Averett & Powell 184.*
C. villosa	12	TEXAS: Presidio Co. 3 mi e. of Ruidosa. *Averett 156.*
	ca. 12	TEXAS: Presidio Co. 3 mi n. w. of Presidio. *Averett 157.*
	12	TEXAS: Presidio Co. 3 mi e. of Ruidosa. *Brey & Powell 61.*
	12	TEXAS: Presidio Co. 14.6 mi s. e. of Ruidosa. *Sikes & Averett 135.*
	12	TEXAS: Presidio Co. 6.8 mi n. w. of Presidio. *Sikes & Averett 141.*
C. crenata	12	TEXAS: Brewster Co. 0.4 mi n. of Black Gap Hdqs. *Averett & Watson 164.*
	12	TEXAS: Presidio Co. 15 mi w. of Lajitas. *Averett 73.*
	12a	TEXAS: Presidio Co. 12 mi w. of Lajitas. *Averett & Watson 66.*
C. cf. crenata	12	TEXAS: Brewster Co. 5 mi n. of Big Bend Nat'l. Park Hdqs. *Averett & Powell 139.*
	12	TEXAS: Brewster Co. 0.4 mi n. of Black Gap Hdqs. *Averett & Watson 166.*
	12	TEXAS: Brewster Co. Head of Boquillos Canyon, Big Bend Nat'l. Park. *Averett & Watson 173.*

DISCUSSION

The only previous chromosome number reported for *Chamaesaracha* has been $n = 12$ for *C. nana* (Raven, 1959). Information given below suggests that cytological data will be of value in understanding the taxonomy of the genus.

Undoubtedly the reader will notice the many tentative identifications (Table I), particularly in reference to *Chamaesaracha sordida*. Actually *C. coronopus* is the only species which seems to exhibit relatively uniform and readily understandable variation, at least in Trans-Pecos Texas.

For the purposes of this report, those collections which are comparable to the type specimen are listed as *Chamaesaracha sordida*. These are believed to be individuals which have chromosome numbers of $n = 24$, mainly because like the type they have leaves which are deeply lobed. Other collections tentatively identified as *C. sordida* have chromosome numbers of $n = 12$, $n = 36$, $n = 18$, and in some cases $n = 24$. Plants of the latter group ($n = 12$, 36, 18, 24) exhibit morphological variation different from that previously understood to typify *C. sordida* (as measured by descriptions and the type).

We also report chromosome numbers of *Chamaesaracha villosa* and *C. crenata*, two species primarily of Mexican distribution in the Chihuahuan desert, both with $n = 12$. Where these compare favorably with the type specimens and original description, they are listed accordingly. Few of our Trans-Pecos collections, however, compare exactly with the type of *C. crenata*, and consequently we have given these only tentative identifications in Table I. It will be necessary to study the Mexican populations of both of these taxa before reliable taxonomic conclusions can be reached.

Chromosome numbers have been obtained from as many as 5 individuals in several populations, while in other cases, only one or a few individual plants were sampled. In every instance the same chromosome number has been found to occur in all individuals of each particular population. Additionally, no morphological or chromosomal entities have been found to occur sympatrically, or at least together in the same population, with the exception that *C. coronopus* and *C.* cf. *sordida* ($n = 12$, and $2n = 48$) occur together on the Sul Ross Campus in Alpine, Texas. Even in this locality there are small clusters of 10 to 20 plants of the same kind, but the species are not intermixed populationally speaking. Also, *C. coronopus* may occur in the same general area with other taxa in the Trans-Pecos (viz., *C.* cf. *sordida*, *C.* cf. *villosa*, *C.* cf. *crenata*), but this species has not been observed growing side by side with any of the others.

As indicated above, populations with differing chromosome numbers generally exhibit morphological features, especially habit, leaf shape, and pubescence, which are distinguishing. Considerable field observations have shown that the variation is not clinal in nature. Whether or not the varying morphology is due to environmental influences, pockets of relatively minor genetic differences, or both, is not clear at this time. Interestingly enough, preliminary 2-dimensional paper chromatographic examinations for phenolic compounds have shown consistent patterns

which correspond positively with the different cytological and morphological entities. Chemical investigations of the genus will be extended yet further, along with more detailed populational analysis.

A great deal of consideration has been given to the possibility that hybridization is occurring between the Trans-Pecos taxa of *Chamaesaracha*. Particularly notable cytological evidence to this effect is brought out with the discovery of a chromosome number of $n = 18$ in one plant (Table I). The meiotic behavior of chromosomes observed in this collection was indicative of well known phenomena associated with hybridization. The number, $n = 18$, was observed in about 100 cells, but in an almost equal number of cells, up to 22 chromosomes could be seen. Further examination showed that chromosomes were not segregating equally at anaphase I. As indicated above, diakinetic and metaphase behavior is difficult to study in *Chamaesaracha*, but it appeared as though normal pairing was not occurring consistently. Unfortunately, the specimen was taken in the process of regional sampling, and no populational data are available. However, if the plant is a hybrid, exomorphic features suggest that only *C.* cf. *sordida* parentage was involved (i.e., $n = 12 \times n = 24$), even though *C. coronopus* is known to occur in the general vicinity (Table I).

The morphic features of the *Chamaesaracha* taxa in question, so far as has been determined, do not serve as "good" markers or indicators of hybridization. Nevertheless, the problem is being approached experimentally (hybridization studies), and chromatographically, and we are hopeful that the origin of at least some of the polyploid populations in the Trans-Pecos can be elucidated.

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STUDIES IN THE EUPATORIEAE (COMPOSITAE), VII. KEY TO GENERA OF SUBTRIBE PIQUIERINAE

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The subtribe Piquerinae has been characterized by having anthers with appendages which are vestigial or lacking. The most recent key to the genera of this subtribe was provided by Robinson (1913) in his generic key to the whole tribe Eupatorieae. Since Robinson's work, six new genera have been described in the Piquerinae alone, and one genus *Podophania* has been reduced to synonymy under *Hofmeisteria* in the subtribe Ageratinae (King & H. Robinson 1966). For these reasons the following key to the genera of the Piquerinae is proposed.

1a Heads one flowered . . . . . *Mexianthus*
1b Heads many flowered 2
  2a Pappus lacking 3
  2b Pappus present 5
3a Flowers asymmetrical, receptacle paleaceous . . . . *Ferreyrella*
3b Flowers symmetrical, receptacle naked 4
  4a Achenes 4-5 ribbed, corollas 5 lobed . . . . . *Piqueria*
  4b Achenes 8-10 ribbed, corollas 4 lobed . . . . . *Piqueriopsis*
5a Pappus composed of long setae 6
5b Pappus composed of short or broad scales 8
  6a Pappus of 5 setae winged at base . . . . . *Ageratella*
  6b Pappus of 10 or more setae not winged at base 7
7a Pappus of 15-35 setae . . . . . *Ophryosporus*
7b Pappus of 10 setae . . . . . *Decachaeta*
  8a Heads 4-8 flowered 9
  8b Heads 10 or more flowered 10
9a Filaments naked, pappus segments few, irregular, and unequal *Phania*
9b Filaments bearing long pubescence, pappus segments numerous, regular and equal . . . . . *Ellenbergia*
  10a Achenes encased in a membranous sac . . . . . *Ascidiogyne*
  10b Achenes not encased in a membranous sac . . . *Trychinolepis*

The genera of the Piquerinae are listed below along with the original publication and type species. In some cases additional pertinent literature is included.

Ageratella A. Gray ex. S. Wats., Proc. Amer. Acad., 22: 419. 1887.
Distribution: Mexico
Type: *A. microphylla* (Sch.-Bip.) A. Gray ex S. Wats., *(Ageratum microphyllum* Sch.-Bip.).

SIDA 3 (3): 163—164. 1967.

Ascidiogyne J. Cuatrecasas, Ann. Missouri Bot. Gard., 53 (3): 310. 1965.
Distribution: Peru
Type: *A. wurdackii* Cuatr.

Decachaeta DC., Prod. V: 133. 1836.
Distribution: Mexico
Type: *D. haenkeana* DC.

Ellenbergia J. Cuatrecasas, Proc. Biol. Soc. Wash., 77: 142. 1964.
Distribution: Peru
Type: *E. glandulata* Cuatr.

Ferreyrella S. F. Blake, Jour. Wash. Acad. Sci., 47: 407. 1958.
Distribution: Peru
Type: *F. peruviana* S. F. Blake

Mexianthus B. L. Robinson, Contr. Gray Herb. 80: 5. 1928.
Distribution: Mexico
Type: *M. mexicanus* B. L. Robinson

Ophryosporous Meyen, Reise I: 402. 1834.
Distribution: Central and South America
Type: *O. triangularis* Meyen.
Additional reference: Robinson, B. L. Proc. Amer. Acad. 42: 17-27. 1906.

Phania DC., Prod. V: 114. 1836.
Distribution: West Indies
Type: *P. multicaulis* DC.

Piqueria Cav., Icon. III: 18 t 235. 1794.
Distribution: Central America, West Indies, South America
Type: *P. trinervia* Cav.
Additional reference: Robinson, B. L. Proc. Amer. Acad. 42: 4-16. 1906.

Piqueriopsis R. M. King, Brittonia 17: 352. 1965.
Distribution: Mexico
Type: *P. michoacana* R. M. King

Trychinolepis B. L. Robinson, Contr. Gray Herb. 80: 6. 1928.
Distribution: Peru
Type: *T. hoppii* B. L. Robinson

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MULTIPLE POLLEN FORMS IN TWO SPECIES OF THE GENUS STEVIA (COMPOSITAE)

ROBERT M. KING AND HAROLD ROBINSON[1]

Abstract. Races occur in both *Stevia pilosa* and *S. purpurea* showing different types of pollen. In each species are found plants (a) lacking distinct pollen, (b) with small tricolpate pollen, (c) with larger asymmetric pollen, and (d) with double pollen. These pollen types probably reflect cytological races.

Plant taxonomists tend to think of pollen as a relatively stable character by which species, genera, and even higher categories of plants may be recognized. Few pollen variations in a single species are reported and most of these involve size differences correlated with polyploidy (Stebbins, 1950). For this reason the discovery of multiple pollen types in some species of the genus *Stevia* seems significant.

The pollen observations reported here are from specimens of two Mexican species of *Stevia* deposited in the U. S. National Herbarium. These specimens of *S. pilosa* Lag. and *S. purpurea* Pers. conform with the concepts in the treatment of *Stevias* of North America (Robinson, 1930). Each species as recognized here appears uniform in all morphological characters other than pollen. The two species share many characters such as small, entire, elliptical, and sessile leaves, and they seem closely related. However, *S. pilosa* is characterized by a pappus lacking setae and which remains immersed in the floral bracts at maturity, and also by the larger leaves subtending the floral heads. *Stevia purpurea* has distinct pappus setae which are exserted at maturity, and the leaves subtending the floral heads are usually very small.

Stevia is a genus of perhaps 300 species restricted to tropical and subtropical areas of the Americas. The basic pollen type in the genus is a tricolpate grain designated here as *Stevia* pollen type I. At least 30 species indigenous to Mexico and the southwestern United States show a unique type of pollen designated here as *Stevia* pollen type II. In *S. pilosa* and *S. purpurea*, the two species that have been studied most completely, all four following pollen types are present:

Aborted: In flowers that are otherwise completely mature, anthers are immature with exothecial cells underdeveloped and distinct pollen grains absent.

Type I: Pollen grains spherical, averaging 25 μ in diameter, tricolpate with intervening spinose faces (Figures 1a, 2a). These are usually radially symmetric but occasionally show one of the faces much larger than the others. This latter condition is particularly evident in one plant *(Schaffner 586)* where the type I pollen occurs intermixed with type II.

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SIDA 3 (3): 165—169. 1967.

Type II: Pollen grains spherical, averaging 30-40 μ in diameter, the furrows and the four intervening spinose plates are usually very asymmetrically arranged most often with one rectangular plate extending ¾ of the way around the grain (Figures 1b, 1d, 2b). These grains possibly represent a modified tetracolpate grain, a form which is sometimes present among the variations.

Type III: Pollen grains elongated, short cylindrical or dumbbell shaped, lesser axes 30-35 μ in diameter, surface markings similar to those of type II but complicated by the double nature of the grain. (Figures 1c, 1e, 2c, 2d).

Repeated examinations show that the pollen types in one anther of any one plant occur in other anthers throughout that plant. If one anther contains type III pollen, all anthers on the plant contain this type of pollen. In plants where both pollen types I and II or II and III are present, both types occur in each anther. In the cases where two types of pollen are present in an anther they are present in nearly equal numbers and are thoroughly intermixed. It seems probable that each pollen mother cell gives rise to both types.

The specimens examined with notes of types of pollen present are given in Tables I and II.

If there are differences between the type I pollens of *S. pilosa* and *S. purpurea*, or between the type II pollens of these species, they are very subtle. However, the type III pollen observed in one plant of *S. purpurea* (*Palmer 463* in part) is very distinct from type III pollen in *S. pilosa*. In *S. purpurea* (Figure 2c) the major furrows are oriented longitudinally, while in *S. pilosa* (Figure 2d) they are oriented transversely. In *S. pilosa* this results in a distinctly girdled appearance of the type III pollen.

The development of pollen types in *S. pilosa* and *S. purpurea* seems to be controlled genetically. There is no obvious correlation with such environmental factors as elevation or progression of flowering season. The pollen types are consistent within individual plants, but often plants collected in the same region, at the same time, and even mounted on the same herbarium sheet may contain different pollen types.

Any attempt to explain the different pollen types in the two species of *Stevia* should consider the following points: (a) the distinctions between pollen type I and the others include a difference in size; (b) that two different types of pollen are capable of occurring in a single anther, probably being derived from a single pollen mother cell; (c) that in some of the plants no distinct pollen is formed; (d) that for *S. purpurea* meiotic configurations showing a variable number of bivalents and univalents, 17(2 to 8_{II}, 30 to 18_{I}), have been reported (Powell and Turner, 1963).

Differences in pollen size are often associated with polyploidy (Stebbins, 1950). Chromosome number of $x = 11$, 12, and 17 have been re-

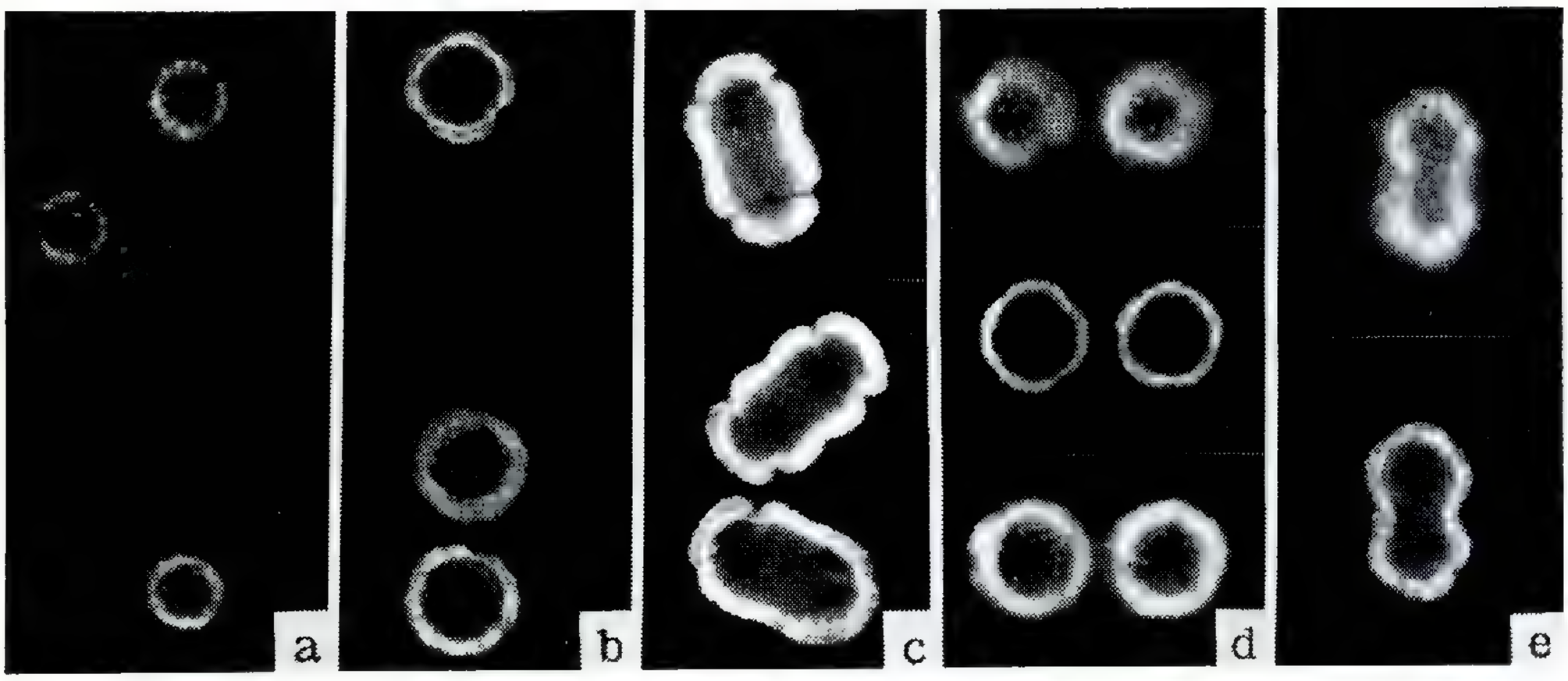

Fig. 1. *Stevia pollen* × 215. (a) *S. pilosa* type I, *Stanford, Taylor, & Lauber 2410;* (b) *S. pilosa* type II, *F. Salazar s.n.;* (c) *S. pilosa* type III, *Pringle 9547;* (d) *S. purpurea* type II, *Lundell & Lundell 12378;* (e) *S. purpurea* type III, *Palmer 463.*

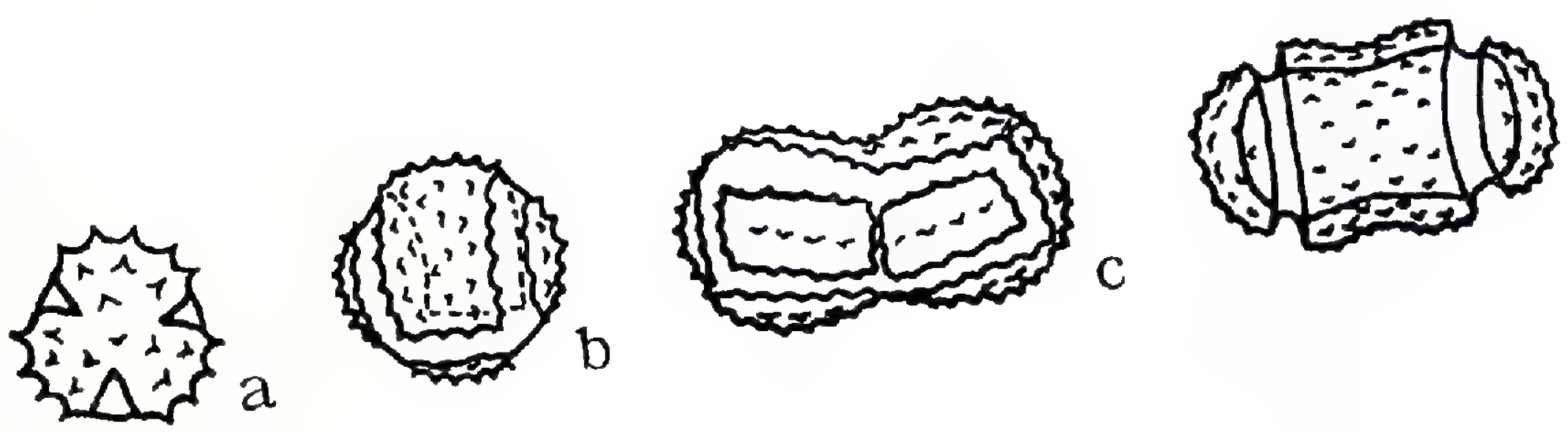

Fig. 2. *Stevia* pollen. (a) type I; (b) type II; (c) *S. purpurea* type III; (d) *S. pilosa* type III.

ported for the genus (Powell and Turner 1963; Turner and Flyr, 1966; Turner and King, 1964). Many of the species in which the higher number has been reported are species in which pollen type II has been observed.

At least some aspects of the pollen form are controlled by the individual haploid pollen grain as is shown by the development of two distinct types of pollen in each anther of some specimens of both species. In one case *(Schaffner 586)* the type I pollen seems to be modified slightly in the presence of type II pollen. This induced asymmetry could be the result of stresses present in tetrads containing two pollen types of different size. This explanation assumes that the genetic mechanism controlling pollen form is under simple Mendelian control.

The appearance of the type III pollen suggests a cell in which division

has been arrested. The pollen grains vary slightly in length and in degree of central constriction, but still show amazing uniformity in shape. Possibly chromosome irregularities in meiosis are involved. If so these irregularities are such that they do not prevent the completion of the meiotic division sequence of the nucleus. This explanation meets complications in light of the specimens having pollen types II and III in each anther. An alternate possible cause is suggested by the lobed microspore derivatives observed in colchicine treated *Coriandrum sativum* by Joshi and Raghuvanshi (1965). In the *Coriandrum* variant the highly lobed grains were found admixed with normal grains from the same tetrad. The lobed grains of *Coriandrum*, however, lacked the uniformity seen in *Stevia*.

We have provisionally concluded that cytological races are responsible for the multiple pollen form in *S. pilosa* and *S. purpurea*. The cytology involved is as yet unknown, but a review of the genus *Stevia* including cytological and biochemical investigations is planned by A. M. Powell of Sul Ross State College, Alpine, Texas.

Table I. Specimens of *Stevia pilosa* examined.

	Pollen Types			
Collection Data	*Absent*	*I*	*II*	*III*
Hidalgo: Sierra de Pachuca, 8 Sep 1899, *Pringle 8236.*	X			
Hidalgo: between Somoriel and Las Lajas, 5 Aug 1905, *Rose, Painter* & *Rose 9232.*	X			
Hidalgo: Cuyamaloya Station, 6 Aug 1906, *Pringle 13781.*	X			
Federal District: Ajusco, 18 Aug 1926, *Fisher 101* (in part).		X		
Federal District: San Andrés, Aug 1932, *Lyonnet 2956.*		X		
Mexico: 30 mi west of Toluca, 17 Jul 1940, *Hitchcock* & *Stanford 7222.*		X		
Nuevo Leon: Pablillo, southwest of Galeana, 28-30 Jun 1934, *Pennell 17089.*		X		
Tamaulipas: 3 mi north of Miquihuana, 12 Jul 1949, *Stanford, Taylor* & *Lauber 2410.*		X		
Federal District: Ajusco, 18 Aug 1926, *Fisher 98.*	X	X		
Mexico: Flor de Maria, 3 Sep 1890, *Pringle 3478.*	X	X		
Mexico: San Bartolito, 4 Sep 1913, *F. Salazar s.n.*		X		
Puebla: Boca del Monte, Aug 1907, *Purpus 2642.*		X		
Mexico: pris Santa Fe, 5 Jul 1866, *Bourgeau 606.*		X	X	
Federal District: Eslaba, 7 Sep 1901, *Pringle 9547.*			X	
Federal District: Eslaba, 18 Sep 1903, *Pringle 11583.*			X	
Veracruz: Mt Orizaba, 8 Aug 1891, *Seaton 275.*			X	

Table II. Specimens of *Stevia purpurea* examined.

Collection Data	*Pollen Types*			
	Absent	*I*	*II*	*III*
San Luis Potosí: Sierra de San Miguelito, 28 Jul 1934, *Pennell 17699.*	X			
San Luis Potosí: San Jose Pass, 22 Jul 1890, *Pringle 3176.*		X		
San Luis Potosí: 5 km west of Guadalcázar, 3 Oct 1954, *Rzedowski 5074.*		X		
San Luis Potosí: San Luis Potosí, 1879, *Schaffner 586.*	X		X	
Durango: Santiago Papasquiaro, Aug 1896, *Palmer 456.*			X	
Durango: El Oro to Guanaceví, 14-16 Aug 1898, *Nelson 4738.*			X	
Durango: Otinapa, 25 Jul - 5 Aug 1906, *Palmer 463* (in part).			X	
Durango: Empalme Purisima, 27 Aug 1934, *Pennell 18251.*			X	
Federal District: Ajusco, 18 Aug 1926, *Fisher 101* (in part).			X	
Hidalgo: trail to Real del Monte on Mt Cerro Ventosa near Pachuca, 13 Sep 1899, *Pringle 7899.*			X	
Hidalgo: between Pachuca and Real del Monte, 31 Aug 1903, *Rose & Painter 6696.*			X	
Mexico: off Toluca road, 14 Aug 1943, *Lundell & Lundell 12378.*			X	
Puebla: Boca del Monte, Aug 1907, *Purpus 2552.*			X	
San Luis Potosí: San Luis Potosí, 1878, *Parry & Palmer 323.*			X	
San Luis Potosí: San Luis Potosí, 1878, *Parry & Palmer 323½.*	X			
San Luis Potosí: San Luis Potosí, 18-20 Aug 1902, *Palmer 37.*	X			
San Luis Potosí: Alvarez, 28 Sep - 3 Oct 1902, *Palmer 167.*	X			
Sinaloa: El Carrizo, 1925, *Ortega 6005.*	X			
Durango: Otinapa, 25 Jul - 5 Aug 1906, *Palmer 463* (in part).				X

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SYSTEMATIC STUDIES IN THE COREOPSIDINAE (COMPOSITAE): NEW COSMOS FROM MEXICO

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COSMOS **ochroleucoflorus** Melchert, sp. nov.

Perennis caespitosa multicaulis suffruticosa rhizomatosa *C. crithmifolio*, affinis, differt floribus disci albidis vel ochroleucis, stylorum ramis purpureis, achaeniis minoribus (10-15 mm lonia, 1 mm. latis) cum aristis longioribus (15-30 mm.).

Clumped, multi-stemmed, suffruticose perennials from elongate, branching rhizomes; stems herbaceous and slender above, but stiffly erect, 45-80 cm tall, leafy throughout, essentially terete, but multi-ridged, the ridges usually stramineous, the depressions greenish, glabrous or with scattered, antrorsely apressed, multi-cellular hairs; leaves narrowly linear, undivided, the principal ones mostly 4.5-13.0 cm long, 0.5-1.5 (2) mm wide, or sometimes 1 (2)—pinnatifid with 3-5 linear segments, these mostly 2.5-5.0 mm long, 0.5-1.5 mm wide, the margins sub-revolute, antrorsely, spinulose-ciliate, the surface glabrous or apressed-hispid; heads 1-few per stem; peduncles slender, 6-15 cm. long; outer involucre of (5-) 8 (-9), linear-lanceolate or linear-sublate phyllaries, these usually with numerous, blackish-green striations and a narrow, scarious border, often becoming stramineous with age; outer palea broadly linear-ovate, becoming increasingly linear toward the center of the head, 9-12 mm long, 0.5-1.5 mm wide; ray florets 5, light pink or lavender, often drying to a deep purple-lavender, broadly obovate, 16-18 mm long, 11-12 mm. wide, 3-toothed at the apex; disc floret 11-17 (-20), white to ochroleucous, their teeth occasionally pinkish-tipped, 8.5-10.5 mm long, scattered pilose, the tube 1.5-2.0 mm long, the limb cylindric, 7.0-8.5 mm long, shallowly toothed, these 1.0-1.5 mm long; filaments densely, short pilose; style branches purple; mature achenes blackish-brown, linear, tetragonal with rounded edges and once sulcate on each face, narrowed apically, but not decidedly rostrate, erect setose, especially above, the body 8-15 mm long, mostly 1 mm wide; pappus of 4 or 5 (-6) retrorsely barbed awns, these 1.5-3.0 mm long, sub-equal or 1 or 2 slightly to much shorter than the others; chromosome number, $n = 22$.

The inclusion of the Durango *Cosmos* populations treated here as *C. ochroleucoflorus* within *C. crithmifolius* by Sherff (1964b) is completely understandable when one considers the many exomorphic features

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shared by these species. Both are suffruticose, multi-stemmed, rhizomatous perennials with slender, sub-glabrous, rigid stems and narrowly-linear, undivided or once-pinnatifid leaves. Furthermore, while most *Cosmos* species are 8-rayed, both *C. ochroleucoflorus* and *C. crithmifolius* have 5 pinkish, or lavender, ray florets.

Though these species are indeed very similar, an examination of their disc florets quickly yields several diagnostic differences. The 11-16 (-18) disc florets of *C. ochroleucoflorus* have white to ochroleucous corollas and purple style branches. By contrast, those of *C. crithmifolius* are mostly 21-27 in number, have corollas which are deep to golden yellow above, grading to light yellow below, and yellow style branches. The size of the mature achenes and pappus lengths also differ quantitatively. The achenes of *C. ochroleucoflorus* have bodies which are 10-15 mm long and mostly 1 mm wide, and awns which are 15-30 mm long (fig. 5). Those of *C. crithmifolius* are 12-18 mm long, 1.2-1.5 mm wide, and have awns which are 3-5 mm long (fig. 6).

Both *C. ochroleucoflorus* and *C. crithmifolius* frequent stony, roadside ledges or roadcuts in mountainous, pine-oak dominated communities. While appearing to be very similar, ecologically, they are decidedly allopatric and seemingly isolated cytogenetically. *C. crithmifolius* is the only wide-ranging, rhizomatous species in the genus occurring from western Jalisco southeastward along the mountains to Guatemala and Honduras; and in eastern Mexico, northward along the Sierra Madre Oriental into Nuevo Leon. By contrast, *C. ochroleucoflorus* is apparently endemic to a small area in the mountains ca 20-40 road miles west of Ciudad Durango, Durango. Chromosome numbers have been determined from 8 Mexican populations of *C. crithmifolius*. In every instance the meiotic complement was $n = 33$ or ca 33 (Melchert, unpublished). When viewed during diakensis I, two or three tetravalents were usually present. Disjunction of these rings is seemingly regular for cells viewed during prophase II. Each cell always had a complement of 33 chromosomes in each half of the diad. Unlike these hexaploids, the 2 populations of *C. ochroleucoflorus* examined were tetraploid, $n = 22$. Meiosis was either completely regular or an occasional ring of 4, or, in one instance, 2 trivalents were seen during prophase I.

SPECIMENS EXAMINED:

MEXICO: DURANGO: Region of mixed pine, oaks, and *Arbutus;* fairly dry and rock region 20 mi w of Cd Durango and 2 mi e of El Soldado along Route 40, 4 Sep 66, *Melchert, Sorensen & Crawford 6283* (Holotype IA); among boulders in pine and oak region 1 mi w of El Soldado along Route 40, 4 Sep 66, *Melchert, Sorensen & Crawford 6285* (IA); in rocky rhyolite soil in open oak and pine woodland about 30 mi w of Durango, 28 Sep 1962, *Cronquist 9540* (MICH, NYBG); 34 mi w of Cd Durango, on highway to El Salto, plateau w of Arroyo Mimbres, sparsely wooded grassland in a pine shaded ravine, 29 Aug 1951, *J. H.*

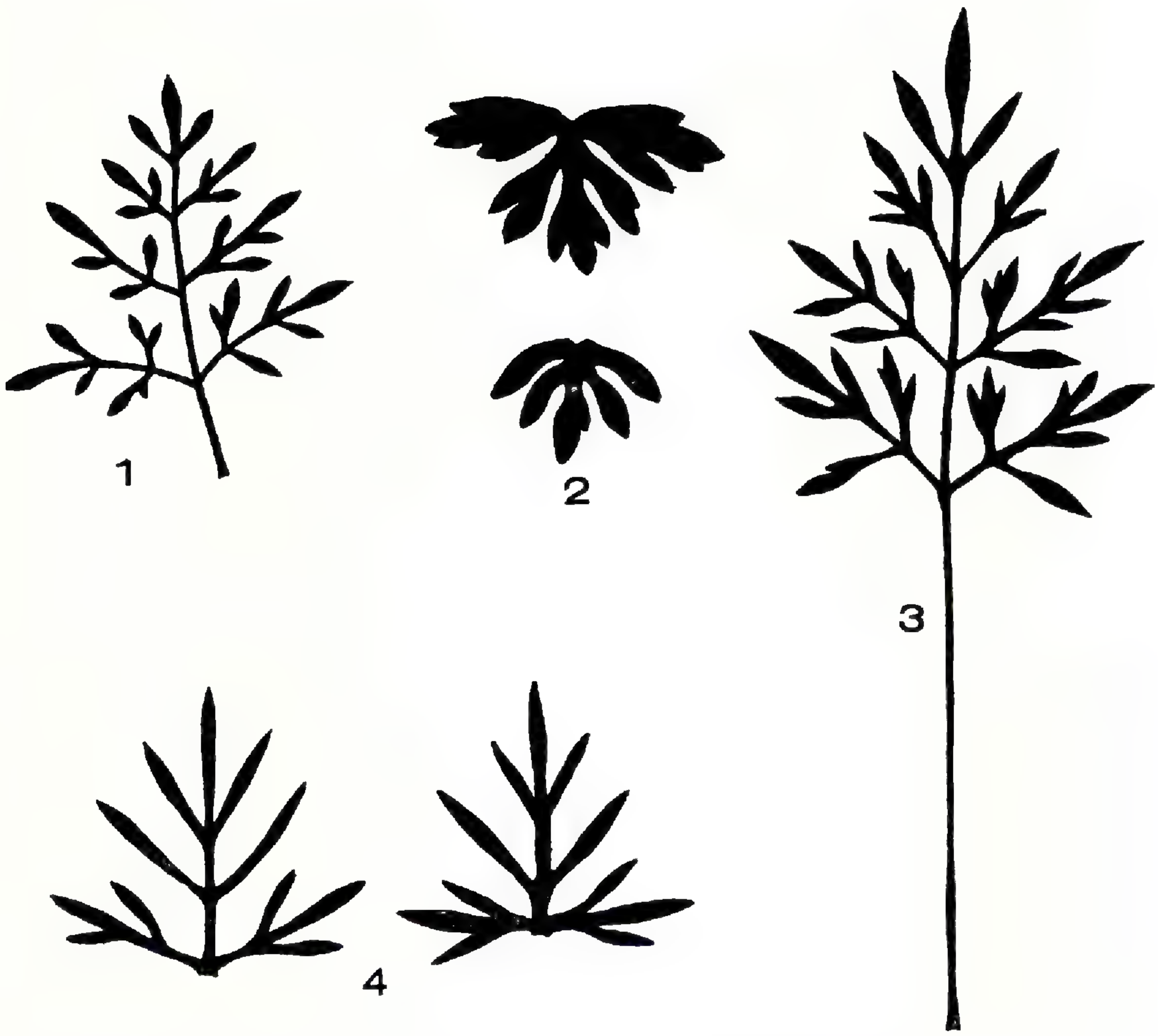
Maysilles 7550 (MICH, F); Quebrada de San Juan, 26 rd mi n of railroad at Coyotes, on rd to San Luis, steep canyon walls and shaded, cool moist ravines, Jul-Aug 1955, *J. H. Maysilles 8048* (MICH); rocky, andesitic pineland canyon, near El Salto, 31 Aug 1934, *F. W. Pennell 18509* (NYBG). Clay and rocky talus slop eat base of cliff 11 mi e of km 1091 and 11 mi e of El Ciudad along Route 40, 6 Aug 1965, *Melchert & Sorensen 6039* (IA).

COSMOS **sherffii** Melchert, sp. nov.

Perennis erecta glabra pluricaulis e radicibus tuberiferis; folia 2—3-pinnatisecta laminis 5—7 (—10) cm. longis, petiolis 10—17 mm. longis; capitula solitaria pedunculis elongatis; flores radii rosacei (sicci lavandulo-purpurei), disci flavi.

Erect, glabrous perennials with several stems from a cluster of tuber-forming roots, stem simple below, branching above, terete; internodes 3-12 cm long; leaves 2-3 pinnatisect, 5-7 (-10) cm long, petiolate, these 10-17 mm long, the lowest pair of primary divisions 2.5-3.5 (-5.0) cm long, the ultimate segments linear-lanceolate or linear-oblanceolate, mostly 2-10 mm long, 1-2 mm wide, the terminal segments to 2.8 cm long, 3.8 mm wide, glabrous, spinulose-ciliate; heads solitary on elongate peduncles, these to 20 cm long; outer involucre of 5-8, lance-linear phyllaries, these 5-8 mm long, light-green, with 3-5, blackish-green veins; inner involucre of 8, oblong-lanceolate phyllaries, these semi-translucent, striate, scarious margined; chaff yellowish-transparent, brown striate, 9.5-11.0 mm long; rays 5-8, sterile, rosaceous, often drying to lavender-purple, narrowly obovate, 20 mm long, 5-6 mm wide, shallowly 3-notched apically; disc florets yellow, 5.5-8.0 mm long, their teeth yellowish-papillate, their tubes 2 mm long; filaments with matted, yellow, pilose hairs; style branches yellow, the stigmatic lines brown; mature fruits unknown; ovaries at anthesis 2-awned, these 1-2 mm long, each with 4 triplets of retrorse barbs; chromosome number, $n = 12$.

Cosmos sherffii is, without doubt, very closely related to the Jalisco endemic *C. longipetiolatus*. A comparative discussion of these two species is found below. Interestingly, the mountainous area ca 25-30 mi nw of Ciudad Oaxaca, where *C. sherffii* is found, abounds with *C. diversifolius*. Like *C. sherffii* the latter is also a lavender-rayed, yellow-disced, tuber-producing perennial. Though distinct morphologically (*C. diversifolius* is primarily scapose, has once-pinnatifid or simple leaves and broadly oblong-lanceolate outer phyllaries; whereas *C. sherffii* is uniformly leafy throughout with 2-3 pinnatisect leaves and has lance-linear outer phyllaries), both species occur in the same pine-oak dominated communities and both have meiotic chromosome complements of $n = 12$ II. While hybridization might be expected under these circumstances, morphological intermediates are unknown. This may be due, at least in part, to phenological differences. In this area of Oaxaca, *C. diversifolius* finishes flowering by late August or early September, at which time *C. sherffii* is just developing noticeable buds.



Figs. 1-4. Leaf silhouettes of *Cosmos* species. Fig. 1. *C. sherffii*. Fig. 2. *C. sessilis*. Fig. 3. *C. longipetiolatus*. Fig. 4. *C. stellatus*.

The only other Oaxacan *Cosmos* species with which *C. sherffii* might be confused is *C. nelsonii*, another Oaxacan endemic with lavender rays, yellow disc florets and 2-3 pinnatisect leaves. They differ, however, in the shape and size of their ultimate segments (broadly lanceolate and mostly 3-5 mm wide in *C. nelsonii* and narrowly-lanceolate and 1-2 mm wide in *C. sherffii*, and in the number and length of their awns (2 awns, these 1-2 mm long at anthesis in *C. sherffii*, and 4 or 5 awns, these 3-5 mm in *C. nelsonii*).

SPECIMENS EXAMINED:

OAXACA: Lightly wooded area high on a steep slope in a zone of pine, oak, and *Arbutus*, soil a clay loam, 30 rd mi s of Nochixtlan and ca 36 rd mi nw of Cd Oaxaca on Route 190, 22 Aug 1966, *Melchert & Sorensen 6165* (Holotype IA); zone of pine, oak, and *Arbutus* ca 29 rd mi nw of Cd Oaxaca and 3-3.5 rd mi n of small village of La Carbonera along route 190, 25 Sep 1966, *Melchert, Sorensen & Crawford 6476* (IA).

COSMOS **longipetiolatus** Melchert, sp. nov.

Praecedenti peraffinis, differt follis 10—23 cm. longis (petiolis 3—9 cm.).

Erect, glabrous perennials with several to many stems from a cluster of tuber-forming roots; stems simple below, branching above, terete, herbaceous, but becoming stramineous and subligneous below; internodes conspicuously elongate, 6-16 cm long; leaves 2 (-3) pinnatisect, 10-23 cm long, petiolate, these 3-9 cm long, the lowest pair of primary divisions 4.0-7.5 cm long, the ultimate segments linear-lanceolate to narrowly lanceolate or oblanceolate, mostly 3-14 mm long, 2-3 mm wide, the terminal segments to 4 cm long, 5 mm wide, glabrous, spinulose-ciliate; heads numerous, solitary on elongate peduncles, these 8-27 cm long; outer involucre of 8, lance-linear phyllaries, these 8-11 mm long, 1-15 mm wide, light-green with 3-5 blackish-green veins; inner involucre of 8, oblong-lanceolate phyllaries, these with numerous, blackish striations, narrow, scarious margins and rosaceous, puberulent tips; rays 8, lavender-purple, sterile, their tips obtuse, sometimes one-notched; disc florets yellow, 5.0-6.5 mm long, their teeth yellow papillate, their tubes rosaceous, 1.5 mm long; filaments short pilose; style branches yellow; achenes 9-12 mm long, glabrous blackish-brown, linear, narrowing slightly apically, tetragonal with rounded edges, each face once-sulcate; pappus wanting, or of 2 minute awns, these to 1 mm long, retrorsely barbed; chromosome number unknown.

Exomorphically, *C. longipetiolatus*, which is known only from one Jalisco collection, appears most closely related to the above-described, Oaxacan endemic *C. sherffii*. Among the tuber-producing species, these are the only taxa with lavender rays and yellow discs whose leaves are both: 1) evenly distributed along their stems and 2) 2-3 pinnatisect with narrowly-lanceolate segments (fig. 1 & 3). While the leaves of these two species are superficially similar, their absolute size ranges are quite different and can be used as reliable diagnostic characteristics. With petioles included, the leaves of *C. longipetiolatus* are 10-23 cm long, as compared to 4-8 cm. in *C. sherffii*. Likewise, the petioles of the former are considerably more elongate (3-9 cm) than are those of *C. sherffii* (1-2 cm).

SPECIMEN EXAMINED:

JALISCO: Open, oak-pine woods in the mountains ca 32 rd mi w of Ayutla and ca 70 m nw of Autlan, elevation ca 6300 ft. 4 Nov 1962, *Cronquist 9803* (Holotype NYBG, Isotypes, F, MICH).[1]

COSMOS SESSILIS Sherff, Brittonia 16:71. 1964

As originally described, *Cosmos sessilis* appeared to have several features which were unique or at least very unusual in *Cosmos*. Most notable among these were its discoid heads and its completely awnless

[1] This specimen was cited by Sherff (1964) in the list of representative specimens following his description of *Cosmos intercedens*. The latter species belongs to the rhizomatous section of the genus and is not close to *C. longipetiolatus*.

Figs. 5-8. Photographs of *Cosmos* achenes. Fig. 5. *C. crithmifolius*. Fig. 6. *C. ochroleucoflorus*. Fig. 7. *C. longipetiolatus*. Fig. 8. *C. sessilis*.

achenes. All other *Cosmos* species are rayed and, with the exception of *C. mcvaughii* and a few awnless individuals of *C. bipinnatus*, *C. sulphureus*, and *C. caudatus*, which were treated as varieties by Sherff (1955), all produce well-developed barbed awns. It now appears that the original description of *C. sessilis*, accurate for the plants involved, merely describes one phase in its floral development. During a visit to the type locality on September 6, 1966, a considerable number of these plants were found in various stages of anthesis. Contrary to the original description, all individuals viewed during the early stages of anthesis had 8 well-developed rays. These were dark, almost blackish-sanguinous, with white pubescence on the veins of the lower surface, obovate, mostly 15-20 mm long, 6-9 mm wide, and irregularly, 1-3 toothed apically. Plants with heads in somewhat later stages of anthesis, however, either had fewer rays, or were completely rayless. These rays proved to be quite delicate and it was difficult to remove a plant from the ground without losing some of them. This ephemeral nature of the ray florets plus the fact that the type collection *(R. McVaugh 19997)* was made almost a month later, October 9, 1960, undoubtedly accounts for the previous treatment of *C. sessilis* as a discoid species.

Sherff's descriptions of the exaristate *Cosmos* varieties mentioned above all include statements indicating that the achenes are even awnless in the ovarial stages. This is certainly not true of *C. sessilis*. At a comparable stage most of its ovaries support 2 minute awns. These are ca 2 mm long and are either smooth or armed with two pairs of retrorse barbs. Apparently, these awns dehise as the achene matures, a developmental feature which accounts for the 2 minute projections at the summit of the mature achene. Certainly, the occurrence of occasional individuals with well-developed awns would not be surprising in *C. sessilis*.

In discussing *C. sessili*, Sherff (1964a) states that "it appears closest to *C. stettatus*. *C. sessilis* differs, however, in being simple below (not basally branched into several stems), with larger, greener leaves, these in pairs, not at all suggesting stars; its head discoid, not beautifully radiate with dark-purplish-red rays; and its ovaries exaristate, not biaristate with retrorsely barbellate aristae."

With the finding of dark-purplish-red rays and awned ovaries in *C. sessilis* these taxa now appear more like geographical variants than species. Morphologically, they differ significantly only in habit (*C. sessilis* has a single stem per plant, whereas the single collection of *C. stellatus* has several stems arising from its tuberous roots) and in the size and degree of dissection of their sessile leaves (fig. 2 & 4). Additionally, the leaves of C. sessilis either diverge from the stem at a right angle, or, more commonly, droop downwards, while those of *C. stellatus* appear to be somewhat apically directed. However, before too much importance is placed on these particular leaf differences it should be noted that their leaf texture is extremely similar and that they are the only two *Cosmos* species with sessile leaves. Furthermore, the degree of leaf variation distinguishing these species is no greater than that found at the infra-populational level in many *Cosmos* and *Bidens* species, cf. *C. palmeri*, *C. ocellatus*, *B. pilosa*, etc. Again, though *C. stellatus* is known from one collection in Michoacan and *C. sessilis* from one Jalisco population, they are both located in the same general range of mountains. Additional information regarding their distributions, their infra- and inter-population patterns of morphological variation, and their chromosome complements are certainly desirable.

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NOVELTIES IN PERITYLE (COMPOSITAE)

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It seems advisable to report these new taxa at this time since my revision of the genus will not appear in print for several months. The Latin diagnoses are by Dr. Hannah Croasdale.

PERITYLE **Warnockii** A. M. Powell, sp. nov. Plantae perennes parvae, 2-10 cm. alt.; folia inferne opposita superne alterna, 8-15 mm. long., 4-8(-10) mm. lat. scabripubescentia, suborbicularia, ovata aut ovato-lanceolata, marginibus conspicue serratis; petioli 2-5(-8) mm. long.; inflorescentia e capitulis solitariis in pedunculis brevibus positis constans; capitula discoidea, campanulata, 0.7-1 cm. alt., 4-7 mm. lat., per folia subtendentia interdum partim celata; disci corollae candidae 5-6 (-6.5) mm. long., tubo glandulari-piloso, fauce subinfundibulari, sparsim glandularipilosa, lobis attenuato-acutis (1.0-)1.2-1.6 mm. long.; achaenia 2.2-2.5 (-2.8) mm. long., oblonga ad oblongo-obconica, ad basim apicemque truncata, marginibus conspicue callosis glabrisque, in superficiebus minute pubescentia; pappus nullus; chromosomatum numerus, $n = 17$. Type: TEXAS: Val Verde Co: n.w. part of county, in crevices and small pockets of solid Cretaceous limestone exposures, ca. 40-50 mi. n.e. of Dryden, ca. 1 mi. e. of Pecos River, 11 Oct. 1964, *A. M. Powell 1311* (Holotype, SRSC; isotypes, GH, SMU, TEX).

This species is closely related to *P. bisetosa* but can be distinguished primarily by suborbicular, ovate, to ovate-lanceolate leaves with conspicuously serrate margins, petioles 2-5(-8) mm. long, disc corollas which are glandular-pilose on the tube and lower throat, and epappose achenes which are truncate at the base and apex.

The specific epithet of the taxon honors Barton H. Warnock of Sul Ross State College. Dr. Warnock has dedicated over 20 years to the collection and study of plants from the floristically rich Trans-Pecos region of Texas. Many of his collections of *Perityle* represent the original records for undescribed taxa in this genus, and his knowledge of populational variability in *Perityle* has been invaluable to my studies of the group.

PERITYLE BISETOSA var. **scalaris** A. M. Powell, var. nov. Plantae perennes in fasciculis parvis erectis pendentibusve, 6-12 cm. alt.; folia inferne opposita, superne alterna, 8-12 mm. long., 5-8 mm. lat., scabri-hispidulosa, ovata aut late ovata ad suborbicularia, omni margine unum duosve lobos acutos et non profundos praebente, aut acute serrato; petioli 2-4 mm. long.; proprietates florales aliquantulum maiores quam in var. *bisetosa*, cetera similes, praeterquam pappus in capitulis nonnullis e 3(4) setis aequilongis, aut seta tertia quartaque breviore, constat;

SIDA 3 (3): *177—180. 1967.*

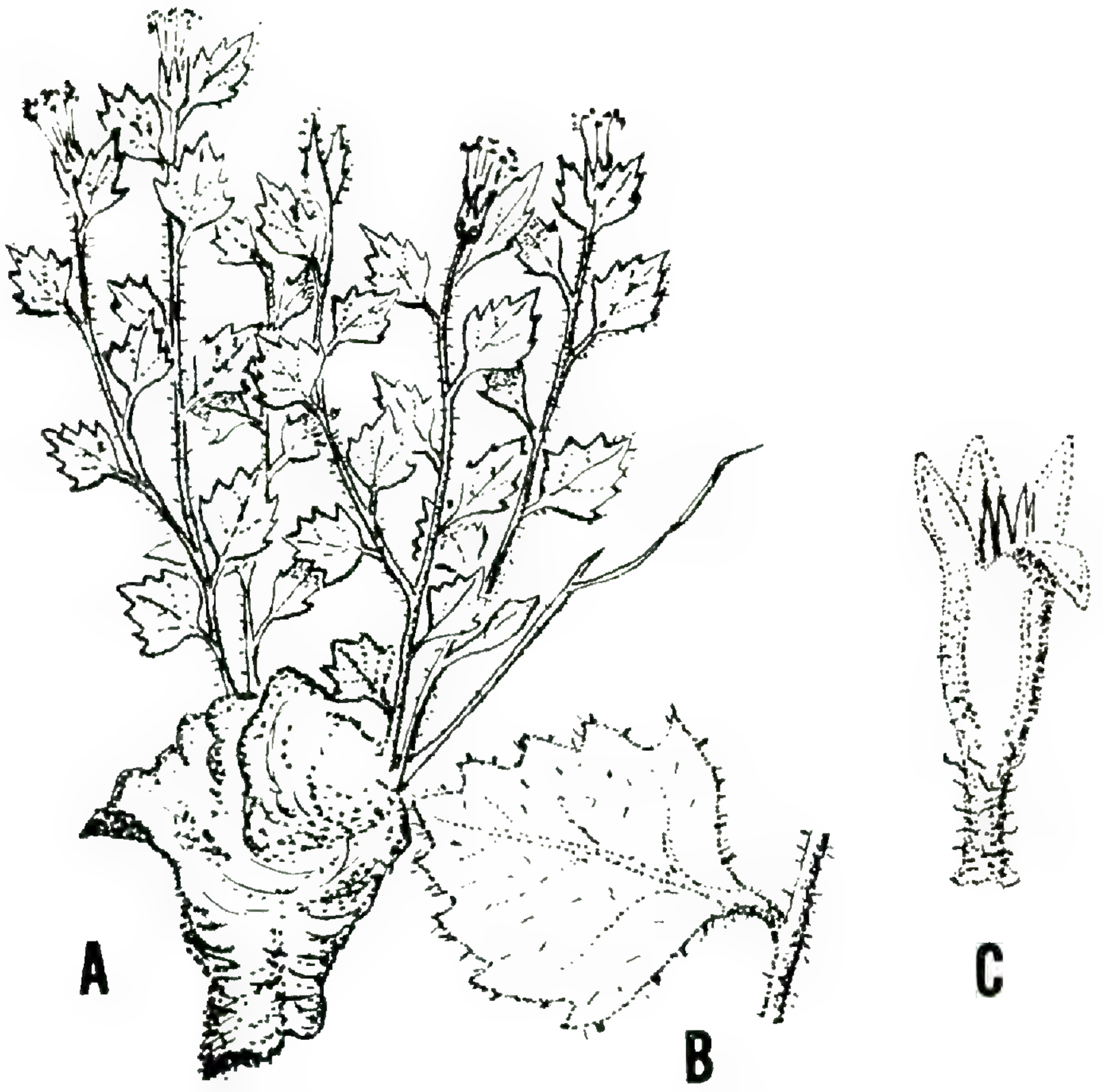

Fig. 1. *Perityle Warnockii (Powell 1311)*. A. Habit sketch, × 1. B. Leaf, × 2. C. Corolla, × 10. D. Achene, × 10.

chromosomatum numerus, n = c. 102. Type: TEXAS: Brewster Co: in crevices of limestone bluffs, Black Gap Game Preserve, ca. 4 mi. s. of headquarters, Cave Hill, e. side, along Stairstep Mt., 25 Sept. 1965, *A. M. Powell & T. Watson 1394* (Holotype, SRSC; isotype, TEX).

This variety is recognizable principally by the following characters: Plants in erect or pendulous clumps 6-12 cm. high; leaves scabrous-hispidulous, ovate to suborbicular, with margins shallow-lobed to serrate; petioles 2-4 mm. long; floral features mostly slightly larger than var. *bisetosa*.

PERITYLE BISETOSA var **appressa** A. M. Powell, var. nov. Plantae

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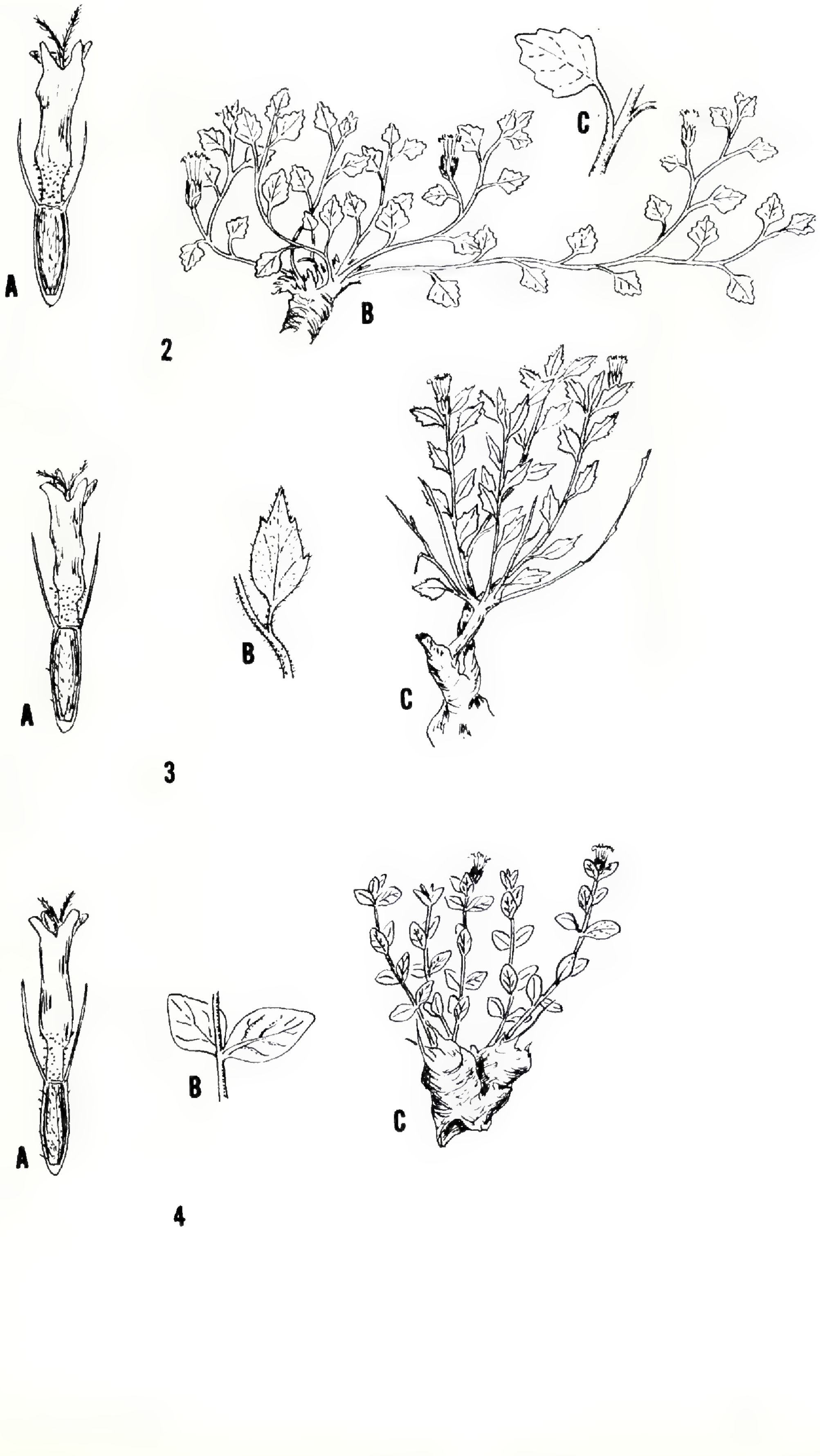
(Opposite) Fig. 2. *Perityle bisetosa* var. *appressa (Scudday, Sikes, and Powell 626)*. A. Floret, × 7.22. B. Habit sketch, × 0.72. C. Leaf, × 1.44 —Fig. 3. *Perityle bisetosa* var. *scalaria (Powell and Watson 1394)*. A. Floret, × 7.22. B. Leaf, × 1.44. C. Habit Sketch, × 0.72—Fig. 4. *Perityle bisetosa* var. *bisetosa (Warnock 18643)*. A. Floret, × 7.2. B. Leaves, × 1.44. C. Habit sketch, × 0.72.


A
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perennes in fasciculis densis foliosisque, ad saxa arcte appressis, 4-8 cm. alt., 12-20 cm. lat. colentes; folia distincete alterna (inferne raro opposita) 10-15 mm. long., 4-8 mm. lat., glabra, ovata, serrata aut serrato-sinuata ad non profunde lobata, omni margine 2 ad 3 (rarius 4) serrationes lobosve typice habente, serrationibus obtusis ad subacutas; petioli 3-7 mm. long.; chromosomatum numerus, $n = 17$. Type: TEXAS: Brewster Co: e. face of the limestone caprock of a small mountain peak on the n. rim of San Francisco Creek Canyon, 5 July 1966, *J. Scudday, S. Sikes & A. M. Powell 626* (Holotype, SRSC; isotypes, GH, SMU, TEX, US).

Perityle bisetosa var. *appressa* is delimited mainly by the following features: Plants growing in dense, leafy clumps closely appressed to rocks, 4-8 cm. high, 12-20 cm. broad; leaves distinctly alternate, glabrous.

PERITYLE RUPESTRIS var. **albiflora** A. M. Powell, var. nov. Corollae disci albidae, folia nonnullarum populationum minora, flosculi capituli numerosiores esse solentes; setae pappi populationum plurimarum breviores quam achaenia esse solentes, adversus var. *rupestris;* chromosomatum numeri, $n = 17$, $n = 34$, $n = 85$. Type: TEXAS: Brewster Co: in crevices of igneous bluffs, ca. 3 mi. w. of Alpine in Tronto Pass, 3 June 1965, *A. M. Powell & S. Sikes 1320* (Holotype, SRSC; isotypes, GH, SMU, TEX, US).

This white-flowered variety is readily distinguished from var. *rupestris* which has yellow flowers.

NOTES

NOTEWORTHY VASCULAR PLANTS OF GARZA COUNTY, TEXAS.—Garza County is located in the southern portion of the Texas Panhandle. It encompasses an area of approximately 914 square miles and can be divided into four distinct physiographic types; high plains, cap rock escarpment, rolling plains, and sand hills.

Approximately one-fourth of its area is of the high plains type, which is clearly delimited by an escarpment, and characterized by a flat, featureless topography. The region is subjected to intense cultivation. Numerous shallow "playa" lakes of recent or Cenozoic origin occur in this type. These lakes are thought to have been formed by the dissolution of subterranian strata allowing the surface to sink. The playas vary in width from a few feet to approximately a mile in diameter and from a few inches to several feet in depth.

The "cap rock" area is an erosion-formed escarpment forming a physiographic boundary between the rolling plains and the high plains. It is topped by a residual stratum of limestone or sandstone. The escarpment area is dominated by mesquite-juniper association.

Below the escarpment are the rolling plains. These range in elevation from 2100 to 2800 feet. Jurassic red bed depositions form the primary soil type in this area.

Deep sand deposits occur as hills in the northeastern corner of the county.

The county is dissected by the erosion caused by numerous tributaries of the Brazos river. Isolated mesic areas are found in sheltered canyons of the cap rock escarpment.

Garza county has an average annual rainfall of 18.6 inches, a growing season of 216 days, a July mean maximum temperature of 95 degrees F. and January mean minimum temperature of 27 degrees F. with a record high of 103 degrees F. and a record low of 0 degrees F.

This investigation was initiated in April of 1965. One of its objectives was to determine to what extent, if any, the vegetation of the Chihuahuan Desert had successfully invaded Garza County. This paper represents a progress report following two years' investigation. An examination of the 365 taxa collected and identified by the author to date, indicates that there are a number of species occurring in the county which normally reach their greatest development in the regions of the Chihuahuan Desert.

The following is a list of range extensions recorded to date. The specimens cited are to be deposited in the herbarium of Texas Technological College, Lubbock, Texas, and duplicates of the author's collection will be deposited in the herbarium of Southern Methodist University, Dallas, Texas. Unless otherwise indicated the collection numbers cited are those of the author.

SIDA 3 (3): 181—183. 1967.

Peganum harmala L. (24 July 1965, 687. 27 Sept. 1965, 886. 7 May 1966, Rollo 148. 28 April 1961, Rowell 8041.) Rolling plains area. V. L. Cory (Field and Laboratory 17: 20-23, 1949) cites this species from Ward and Reeves counties. This represents a range extension of approximately 170 miles north.

Epipactis gigantea Dougl. ex Hook. (14 July 1965, 673. 19 April 1966, 1053. 16 May 1966, 1121. 22 May 1966, 1150.) Mesic area of Cooper's Canyon. D. S. Correll (Additions to the Orchids of Texas: 169, 1947) cites collections in Kendall and Presidio Counties. These counties are approximately 400 miles southeast and 220 miles southwest, respectively, from Garza county. Collections are cited for Wise County which is about 300 miles east of Garza county. (The Flora of Texas, 1944 Vol. 3, part 3.)

Nicotiana trigonophylla Dunal (20 June 1965, 619.) Breaks of the cap rock escarpment. T. H. Goodspeed in "The Genus Nicotiana" (Chronica Botanica 16: 1-536, 1954.) cites this plant from the Texas Trans-Pecos area and New Mexico, approximately 200 miles southwest of Garza County.

Isocoma wrightii (Gray) Greene (I. heterophylla (Gray) Greene, Haplopappus heterophyllus (Gray) Blake, H. plurflorus of Texas authors.) (4 July 1965, 639.) Cap rock breaks below escarpment near southern edge of Garza County. Wooten and Standley (The Flora of New Mexico; 665-666, 1915.) cite this species as ranging from West Texas to southern New Mexico. F. W. Gould (Texas Plants- a Checklist and Ecological Summary, June 1962.) lists this species from the Trans-Pecos area of Texas only.

Zephyranthes longifolia Hemsl. (14 June 1965, 605. 21 June 1966, 1232. 21 June 1966, 1233.) Collected on the high plains. Fred B. Jones of Corpus Christi, in a private communication (8 April 1966) stated the known range of this plant was from Arizona to far West Texas and southward into Central Mexico, and that the author's collection may be the farthest north, at least in Texas.

Verbena halei Small (9 May 1965, 453. 18 April 1966, 1049. 12 May 1966, 1101.) Low moist areas of rolling plains. H. N. Moldenke (The Flora of Texas, 3(1):21-23, 1942) cites collections from Throckmorton, Callahan, and Brewster Counties, the nearest of these being approximately 130 miles east of Garza County.

Atriplex confertifolia (Torr. & Frem.) S. Wats. (13 August 1965, 839. 6 September 1965, 857.) Collected in cap rock breaks near the southern border of Garza County. P. C. Standley (North American Flora, 21(1): 1-93, 1916) cites dry plains and hillsides—North Dakota to Chihuahua, California, and eastern Oregon. Wooten and Standley (The Flora of New Mexico; 201-205, 1915) cited the dry plains and lower hills of the upper Sonoran zone as the range of this plant. Gould does not list this species.

Krameria glandulosa Rose and Painter (2 May 1965, 417.) Limestone soils of the cap rock escarpment. B. L. Turner (Legumes of Texas, 80, 1959) indicated the range of this plant extending northward from the

Trans-Pecos only into Loving County, an extension of about 155 miles northeast.

Desmanthus obtusus Wats. (3 June 1965, 532. 6 July 1966, 1250.) Collected in the rolling plains. B. L. Turner (Legumes of Texas, 57, 1959) cited this plant from Howard, Martin and Mitchell Counties, about 80-100 miles south of Garza County.

The following plants are range extensions according to Gould's "Texas Plants—a Checklist and Ecological Summary."

Parthenium lyratum Gray (7 November 1965, 958.) Collected in the margin of a playa lake. Listed by Gould up to Sterling County, 120 miles south of Garza County.

Viguiera stenoloba Blake (12 July 1965, 650.) Collected in breaks of cap rock escarpment. Listed from the Trans-Pecos area by Gould.

Cressa truxillensis H.B.K. (5 June 1965, 585. 9 June 1966, 1185.) Collected in rolling plains and listed from Trans-Pecos by Gould.—*Charles R. Hutchins, Department of Biology, Texas Technological College, Lubbock, Texas 79409.*

POLIANTHES ROSEI SHINNERS, NOM. NOV. (AGAVACEAE).—Based on *Manfreda elongata* Rose, Contrib. U.S. Nat. Herb. 8: 21. 1903. *Polianthes elongata* (Rose) Shinners, Sida 3: 337. 1967. Not *P. elongata* Rose, Proc. U.S. Nat. Mus. 29: 437. 1905. *Agave gracilis* Berger, Die Agaven p. 33. 1915. Not *Polyanthes gracilis* Link, Enum. Pl. Hort. Reg. Bot. Berol. Altera 1: 330. 1821. On filing a new issue of the Gray Herbarium Card Index, I found a previously missed entry for Rose's 1905 name. Our older issues are photocopies on thin paper, two of which must have been stuck together when I checked the Index in preparing my *Polianthes* paper. Berger's substitute name is also preoccupied under *Polianthes*, making a new epithet necessary.—*Lloyd H. Shinners.*

BURMANNIA BIFLORA (BURMANNIACEAE) AND BOWLESIA INCANA (UMBELLIFERAE) IN OUACHITA PARISH, LOUISIANA.—*Burmannia biflora* L. is relatively abundant in swampy woods at the edge of Tanyard Brake southeast of Luna (*Thomas & Jones* 770, 13 Oct. 1966). Louisiana is within the Manual range of the species, but these are the first specimens from the state that the author has seen. Jonker's "A Monograph of the Burmanniaceae" (Meded. Bot. Mus. & Herb. Utrecht No. 51, 1938, p. 80) gives New Orleans as the only definite locality, listing several other collections as "without locality." Those credited to Torrey, Short and Gray must have been received from others, since these men did not collect in Louisiana; that of Drummond must have come from southeastern Louisiana, the only portion of the state in which he collected; that of Hale may have come from Alexandria. In any case, the Ouachita Parish record is a notable inland extension of range.

Bowlesia incana R. & P. was reported from St. Martin Parish by John W. Thieret (no. 17063, 3 April 1964; see SIDA 1: 294, 1964). It was collected earlier but not reported by Robert Kral (no. 8226, 5 March 1959, SMU), as a lawn weed in Monroe. It is abundant as a lawn weed beside Garrett Hall on Northeast Louisiana State College Campus at Monroe *(Thomas 1845,* 18 March 1967).—*R. Dale Thomas, Biology Department, Northeast Louisiana State College, Monroe, Louisiana 71201.*

THREE OBSERVATIONS ON VIOLA (VIOLACEAE) IN NACOGDOCHES COUNTY, TEXAS.—While studying *Viola* in Nacogdoches County, Texas, 1953-1966, two instances of the effect of environmental change on the gross morphology of the native stemless blues were noted. Edgar Anderson (1955) and W. H. Camp (1961) reported similar experiences in the taxon.

In 1934-35, a CCC road was built through a wooded area. The sunlight at its intersection with an older road was increased. A plant with sagittate leaves was collected at the junction of the two roads by Donald Feazell, March 9, 1947, and is in the herbarium of Stephen F. Austin State College, Nacogdoches, Texas. The CCC road was not kept up after World War II and was closed by fencing in 1952. The shade of the area had increased when, in 1963 and 1964, no plants with sagittate leaves were present. The population had the leaves of *Viola Lovelliana* Brainerd, with spreading, two- or three-cleft lateral lobes.

In March, 1960, 50 plants in a population of *V. Langloisii* Greene were examined. The flowers of all had a glabrous spur petal, an important point of difference from *V. affinis* LeConte, its close relative here, which has a bearded spur petal. No other non-*Langloisii* characters were observed. Upon returning to the population in March, 1963, the habitat was much more open and sunny as extensive lumbering had occurred. Of 14 plants examined, 12 had flowers with bearded spur petals. The population was no longer *V. Langloisii* in all its characters.

My data on the stemless blues of Nacogdoches County point to the absence of genetic barriers between them. An introduced violet *is* genetically distinct with three characters never seen in the natives although it has grown among them, in many locations, for 43 years. They are 1. large, long stigmatic aperture on the top of the pistil whose summit is slightly rounded; 2. filaments above the anthers white, cream or pale yellow, never orange; 3. never varying broad petals of never varying true white that shows no color when pressed. It keys to *V. sororia* Willdenow. One of our native phenotypes also keys to *V. sororia* Willdenow although it differs from the introduced taxon in the above three characters.

Dr. Victor J. Hoff, Stephen F. Austin State College, Nacogdoches, Texas, kindly suggested useful changes in the wording of these notices.
—*Janice Burroughs Lacey, Drawer 1312, Nacogdoches, Texas 75961.*

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ANDERSON, E. 1955. Confederate Violets. Landscape, Summer 1955: 7-11.

CAMP, W. H. 1961. The Pattern of Variability and Evolution in Plants. A Darwin Centenary, Arbroath, T. Buncle & Co. Ltd. September 1961: 59-68.

BUPLEURUM LANCIFOLIUM (B. SUBOVATUM) (UMBELLIFERAE) IN TEXAS.—In The Vasculum for July, 1967 (vol. 52 no. 2, p. 14) is a short note by Michael Mullin reporting that several specimens from the vicinity of Durham, England, at first thought to be *Bupleurum rotundifolium* L. proved on closer examination to be *B. lancifolium* Hornem. (*B. subovatum* Link). Examination of 10 North American sheets in SMU Herbarium filed as *B. rotundifolium* revealed that two from Texas were *B. lancifolium,* and one from North Carolina was apparently the same. TEXAS. Harris Co.: Houston, garden weed, *Edna Miner,* 2 May 1964. Webb Co.: Laredo, Lake Casa Blanca, *Terry Tarvin 65,* 1 April 1964. NORTH CAROLINA. Forsyth Co.: Winston-Salem, *P. O. Schallert (Salem College Herb. No. 805),* 20 July 1932 (with very immature, faintly granulose fruits; umbels 1—3-rayed). This species differs from *B. rotundifolium* in having somewhat narrower leaves, umbels with 2—5 rays (instead of 4—10), and granulose or closely warty-roughened fruits (instead of smooth ones) (cf. Mathias and Constance, North Amer. Fl. 28B pt. 1: 135—137, 1944; Clapham, Tutin and Warburg, Flora of the British Isles, ed. 2, pp. 511—512 1962). These features are well shown in a specimen at SMU from ITALY: Triest, Muggia, *Dr. F. Höpflinger,* 15 July 1953. The other North American specimens (from Arkansas, Missouri, Tennessee, Virginia, and West Virginia) were correctly named *B. rotundifolium,* as was one Texas collection (Dallas Co.: Oak Cliff, Dallas, *Ernest F. Couch,* 24 April 1958; voucher for the report of this species by the collector in Field & Lab. 26: 84, 1958). According to Mullin, the plant was introduced at Durham, England, with bird seed; the means of its introduction into Texas is unknown.—*Lloyd H. Shinners.*

MONOTROPSIS LEHMANIAE A SEASONAL PHASE OF M. ODORATA (ERICACEAE).—The Monotropoideae of the Ericaceae have long been a confused and little understood group. A few years ago, Oscar Gupton, Virginia Military Institute, worked on *Monotropa* for a dissertation. It was my pleasure to spend considerable time in the field with him and to examine quite a few herbarium sheets of this group. It was his careful observation that made it clear to me as well as himself that the multiflowered group of *Monotropa* was not many species as so often interpreted, but a highly polymorphic species *(M. hypopithys)*, in which all the characteristics used for separation integrated. This was also true of the uniflowered group *(M. uniflora)*. However, there were some baffling factors that had to be considered. *M. hypopithys* that flowered from late May-July were pale yellowish to brownish, the later July-Oct. were mostly red, the flowers tipped with yellow; occasional all-yellow plants could be found in a colony, but these obviously were merely color forms. *M. uniflora* flowering June-July were pure white and not fragrant, while those flowering from Aug.-Oct. were mostly pink, reddish, yellow, to pale bluish, and often very fragrant. Carroll Wood in his treatment of the group for the southeastern generic flora suggested that the autumnal flowering of these two species were phases of the earlier blooming plants. The term "phase" indicates to me that they are the same plant with different forms. This is not true and I am uncertain that this is what was meant. Colonies that flowered early were carefully watched; they did not flower again in the autumn. Autumnal flowering colonies were watched and they did not flower in the early part of the following year.

With the above facts at hand, I assumed that late flowering, lavender colored plants of *Monotropsis lehmaniae* were exhibiting the same phenomena and proceeded to transfer it to varietal status of *M. odorata* for the treatment in the "Guide to the Vascular Flora of the Carolinas". Now I regret that the combination was made, since careful observation reveals a totally different situation. In March, 1965, Jay Shuler of Greenville, S. C. wrote to me that he had found *Monotropsis odorata* in Oconee Co., S. C. The following week-end I visited with him and went to the locality, so as to beocme familiar with the plant in the field. On May 1, 1965, I was fortunate in finding a stand while collecting in Hanging Rock State Park and a second stand outside the park. Then on Oct. 9, 1965 while again collecting in the park we found quite a few clumps of *M. lehmaniae*, one of which was in the very same place in which we had previously found *M. odorata*. The question then arose, could this be the very same plant that had flowered earlier? On Feb. 20, 1966 we again visited the park, and where we remembered having found so much *M. lehmaniae* in the autumn, careful search revealed numerous stems of *M. odorata* in bud.

SIDA 3 (3): 186. 1967.

It is now my belief that *M. lehmaniae* is nothing more than an autumnal flowering phase of *M. odorata*. The scarcity of collections of these plants may be explained in several ways. The dull grayish-brown color of the dried bracts that conceal the spring flowering phase make it very difficult to find among the dried leaves, while the more conspicuous lavender colored fleshy phase in the autumn only appears when the buds, already protruding above the ground for the next season are forced into bloom by ideal conditions, which probably occur only in exceptional seasons. The bracts which are at first fleshy become dried out and hardened due to the dry conditions in the late autumn and winter, causing the dried characteristic bracts of spring plants. Probably a chemical change takes place due to coldness causing a change in color and creating a delightful fragrance present in the spring.—*Harry E. Ahles, Department of Botany, University of Massachusetts, Amherst, Massachusetts 01002.*

HOTTONIA INFLATA (PRIMULACEAE) IN OUACHITA PARISH, LOUISIANA.—*Hottonia inflata* Ell. has been reported in Louisiana only from St. Landry Parish. A second location can now be added: in a small tupelo-cypress swamp just east of Monroe in Lakeside Subdivision, Ouachita Parish. A large colony was found dislodged from the soil and with the under-water leaves partially gone. These plants are in a newly developing subdivision and are in danger of extinction. Specimens of the original collection by Joan Hutto (May 1, 1967) are in the Herbarium of Northeast Louisiana State College and the U.S. National Herbarium. Additional specimens *(Thomas, Hutto & Hutto 2582,* 7 May 1967) are being distributed.—*Joan Hutto and R. Dale Thomas, Biology Department, Northeast Louisiana State College, Monroe, Louisiana 71201.*

NEOGAERRHINUM KELLOGGII (GREENE) THIERET, COMB. NOV. (SCROPHULARIACEAE).—Based on *Antirrhinum kelloggii* Greene, Bull. Torr. Club 10: 126. 1883. *Maurandya stricta* Hook. et Arn., Bot. Beechey 375. 1838. *Antirrhinum strictum* (Hook. et Arn.) Gray, Proc. Amer. Acad. 7: 375. 1868, non *A. strictum* Sibth. et Sm., Fl. Graec. 6: 75. 1826. *Antirrhinum hookerianum* Penn. ex Millsp., Field Mus. Bot. Ser. 5: 222. 1923. *Asarina stricta* (Hook. et Arn.) Penn., Proc. Acad. Nat. Sci. Phila. 99: 175. 1947. Preparing an account of the vines of the Scrophulariaceae, I uncovered the need for the above new combination. I prefer to treat this Californian species under the segregate genus *Neogaerrhinum,* as did Rothmaler (Repert. Spec. Nov. Regn. Veg. 52: 31. 1943.), the most recent student of the tribe Antirrhineae as a whole, rather than under *Asarina,* as did Pennell *(in* Abrams, Illus. Fl. Pacif. States 3: 783. 1951.), or under *Antirrhinum,* as did Munz and Keck (A Calif. Fl. 652. 1959.).—*John W. Thieret, University of Southwestern Louisiana, Lafayette.*

REVIEW

A DICTIONARY OF BOTANY. George Usher. 404 pp. D. Van Nostrand Company, Princeton, New Jersey, 1966. $10.00.

This book was written and printed in Great Britain. That it ever left its insular birthplace is regrettable. It is certainly one of the shoddiest biological productions that has crossed the Atlantic. Doubtless a candidate for the year's finest example of understatement is Usher's assertion that "Inevitably in a book of this nature, mistakes will have crept in . . . ." Mistakes—factual and editorial—have indeed crept in and have almost overwhelmed the book.

When I began my examination of this odious opus, I soon concluded that some sort of error could be found on every page, but further study convinced me that there are some pages with which I am unable to find fault—at least among the terms I know (I did not bother to check the others). Such error-free pages, however, are not to be found under "C," the letter I chose at random for extra careful perusal of its entries. Of the 48 pages of "C's" *not one page* is without fault. Of the *circa* 950 "C" entries, 150 have been marked by me as having something wrong with them.

The myriad faults in this lexicon are of every conceivable kind. Most appalling, of course, are the many definitions that are wrong, unclear, or meaningless. After the reader notes such definitions given for words he *knows*, he certainly cannot trust definitions of words he does *not* know. The book is rife with misspellings, both of words being defined and of words used in the definitions. Many entries in the singular are defined as if they were in the plural, and vice versa. Some nouns are defined as if they were adjectives. Subjects frequently disagree in number with their verbs. The spelling of many words and of plural forms is not consistent throughout the book. The antecedent of many pronouns is not clear. Many definitions are so constructed that it is uncertain which phrase or clause modifies which noun. Commas are used overabundantly where they are not needed but are often omitted where their use could have increased clarity. Entries in the dictionary are not even always in alphabetical order. Past tense is used in the definitions of some fossil taxa but not in others. Some fossil taxa are not even indicated as being fossil. On page 102 we read: "CYANOPHYCEAE = MYXOPHYCEAE"; on page 244 we read: "MYXOPHYCEAE = CYANOPHYCEAE."

Many words are defined in one way and then used elsewhere in the book in a way not consistent with the definition. For example, "epigynous," "hypogynous," and "perigynous" are defined as describing flowers but are often used in definitions to describe sepals, petals, and stamens; "flower" is defined as being an angiosperm structure but is often used in definitions of gymnosperms; "leaf" and "stem" are defined as being structures produced by vascular plants, but these terms appear in

many definitions of bryophytes (sometimes in quotation marks, sometimes not). "Dioecious" is defined as applying to plants but is frequently used to describe flowers. "Monoecious" is "Bearing unisexual flowers on the same plant," an enigmatic statement indeed.

Knowledge of angiosperm morphology is obviously not one of Usher's strong points. After learning that the endosperm of Anonaceae is "ruminant," I was relieved to discover that the endosperm of Magnoliales is "not ruminant." A "capsule" is "A dry indehiscent fruit . . . ," thus being deprived of one of its major attributes, dehiscence. A pollen tube now contains at least three male gametes: "A tube . . . that carries male gametes to the egg, and one to the central fusion nucleus . . . ." "Central fusion nucleus" is not defined in the book. "Embryo sac" is defined as "The female gametophyte (megaspore) of angiosperms." "Megasporocyte" is "The female gametophyte of angiosperms." "Microsporocyte" is "A male gametophyte in the Angiosperms." Under "Angiospermae" the term "ovules" is equated with "female gametophytes," and "pollen-grains" is equated with "male gametophytes." Under "carpel" we learn that "The total of the carpels in a flower is the ovary." A "gamete" is "A haploid cell taking place in sexual fusion."

Among the most futile portions of the book are Usher's attempts to define families and higher taxa of plants. Most of these "definitions" are hopeless potpourri of data from Bentham and Hooker, Engler and Prantl, and Hutchinson. They constitute a cross-section of the editorial and factual errors that plague this book, and so just a very few of them will be cited here (comments in brackets are mine).

ACANTHACEAE: "Found in the tropics and sub-tropics." [What about the Acanthaceae in the range of *Gray's Manual of Botany?*] ACERACEAE: "Confined to the temperate areas of the Northern Hemisphere." [*Acer* crosses the equator in Malaysia.]; "Maple, Sycamore, Sugar Maple." [Sycamore, to North American users of this book, is *Platanus*, not *Acer*.] ALISMACEAE: "perianth of two whorls of three, calyx-like lobes." [Certainly not applicable to any alismaceous plant known to me.] AMARANTACEAE: "The fruit is a berry or not." [i.e., nut.] ANCISTROCLADACEAE: "The ovary has one loculus and contains one ovary." [A good trick, if one can do it.] ANTONIACEAE: "the fruit is a capsule which usually dehisces into 7." [7 what? Note that 7. It will be back in the most unusual places.] BACILLARIOPHYCEAE: "having a cell-wall . . . containing cilia . . . ." [i.e., silica.] BIGNONIACEAE: "The capsule is 7-septate . . . ." [It is not. Here's the 7 again.] BUDDLEIACEAE: "There are usually many ovules in each ovule . . . ." [Another good trick.] CABOMBACEAE: "There are 3 sepals and petals." [There are three of *each*.] CAMPANULACEAE: "The bisexual flowers are . . . in fives . . . ." [The flower *parts* are in fives.] CANNACEAE: "The androecium consists of 1 stamen, which has one loculus, the rest are petalloid." [?] CASUARINALES: "These are tree shrubs . . . ." [??] CUSCUTACEAE: "These are leafless, parasitic herbs, with thin,

climbing." [???] DATISCACEAE: "These are trees of herbs . . . ." [????]; "The . . . calyx lobes . . . may be free or untied . . . ." [i.e., united.] ELATINACEAE: "The fruit is a capsule, which breaks into seven." [Once again, that persistent 7—this time spelled out.] GENTIANACEAE: "The calyx have usually 5 imbricate fused petals." [*Really*, Mr. Usher!]; "The fruit is usually a capsule with 7 cavities . . . ." [Not so. Anyway, here's another 7.] LEMNACEAE: "usually with no leaves . . . ." [Has Usher ever seen a duckweed *with* leaves?] NYSSACEAE: "These are shrubs . . . ." [A *Nyssa sylvatica* with a trunk 3 feet in diameter is hardly a shrub.] PINACEAE: "These are mostly monoecious having perfect cones." [Elsewhere in the book, "perfect" is defined as applying to flowers; you will recall that Usher defines "flower" as being an angiosperm structure. But no matter how you look at it, Pinaceae do not produce "perfect" cones.] TROPAEOLACEAE: "These are usually climbers with a sensitive petiole." [Just one?]; "the Pseeds have no endosperm." [The "P" is silent, of course, even if it *is* upper-case.] And so this dictionary's definitions go—for page after page after page.

It is almost incomprehensible to me that a leading scientific publisher could (1) accept for publication such a poorly done work as this and (2) publish it. Do not publishers have an obligation to the purchasers of their books to have manuscripts reviewed by competent reviewers? Such review was not done in the case of this dismal dictionary—or else the reviewers were not competent or did not do their job conscientiously. Do not publishers have an obligation to have their books carefully edited and proofread? Careful editing and proofreading did not play a part in the construction of the Usher dictionary—or else the editors and proofreaders were not worth their pay. Von Nostrand has disgraced itself—and has insulted the botanical fraternity—by publishing such a trashy work, a work with but one saving grace: it has only 404 pages.

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PARIETARIA PRAETERMISSA (URTICACEAE), A NEW SPECIES FROM THE SOUTHEASTERN UNITED STATES

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Thomas Nuttall, in *The Genera of North American Plants* (1818), described a new annual species of North American *Parietaria, P. floridana,* which he characterized as follows (p. 208): "Leaves roundish-ovate, obtuse, as long as the petiole and opaquely punctate; flowers glomerate, equal with the involucrum; stem erect. HAB. Near St. Mary's, West Florida.—Dr. Baldwyn. Apparently intermediate between *P. pennsylvanica* and *P. lusitanica.* Leaves not minute, pilose, 3 or 4 lines wide, and with the filiform peduncle an inch long; involucrum inconspicuous; stem about 10 to 12 inches high." The name *P. floridana* Nutt. has come to be applied, wrongly, to another species that ranges over much of southeastern United States.

John Kunkel Small, in *Manual of the Southeastern Flora* (1933), described another annual *Parietaria,* also from Florida, as *P. nummularia.* This species was characterized as follows (p. 434-435): "Stem usually branched at base, the branches becoming assurgent or prostrate, mostly 1-3 dm. long: leaf-blades reniform, to rhombic-orbicular or orbicular-ovate, obtuse, relatively long-petioled: sepals abruptly pointed: achene ellipsoid, less than 1 mm. long.— Wet sandy soil, often in hammocks, E and pen. Fla.—The numerous very small leaves gives this plant the aspect of a small-leaved *Pilea.* Specimens of this species and those of *P. floridana* have erroneously been referred to the New Zealand *P. debilis.*" According to Small, *P. nummularia* can be distinguished from *P. floridana* by its leaf blades, which are "mostly as wide as long or wider, mostly 0.5 cm. wide," those of *P. floridana* being "manifestly longer than wide, mostly 1-6 cm. long . . . of an ovate or elliptic type," and by its achenes, which are "less than 1 mm. wide [i.e., long]," those of *P. floridana* being "over 1 mm. long." I agree with Small that his *P. nummularia,* which ranges from Delaware to Florida, Louisiana, and Texas, is readily separable from the taxon long-called *P. floridana* although vegetative features alone are not reliable to distinguish the two.

During my study of the annual *Parietaria* of continental United States and Canada, I examined the types of *P. floridana* Nutt. (Near St. Mary's, West Florida, *Baldwyn,* PH) and *P. nummularia* Small (Sanford, Florida, *Rapp,* 11 April 1929, NY) and have found that both are plants of the same species.

SIDA 3 (4): *191—194. 1968.*

The name *P. floridana* Nutt., with 115 years of priority, must, therefore, be applied to the taxon that Small called *P. nummularia*. The taxon to which the name *P. floridana* has long been misapplied is in reality, then, an undescribed species, for which the following name and description are proposed.

PARIETARIA **praetermissa** Hinton, sp. nov.

Annual, prostrate to erect herb with fibrous roots. Stems simple or more commonly branched at the base, finely or minutely pubescent to densely pubescent, terete, faces of internodes smooth to slightly grooved. Leaf blades deltoid to broadly ovate, 4-60 mm. long, 3.75-24 mm. wide, widest at the base or at about the middle, palmately 3-veined, apex rounded to abruptly short-acuminate, base truncate to obuse or rounded; upper surface smooth or with sparse fine or minute pubescense, more pubescent on the veins. Petiole 4-33 mm. long, usually as long as the width of the blade or longer. Involucral bracts lanceolate to broadly linear, shorter to longer than the calyx, 2.0-5.5 mm. long, 0.3-1.3 mm. wide, pubescent, ciliate on the margins with long hispid and short curled hairs. Calyx tubular for one-half its length, dark reddish-brown at maturity, 2.0-4.0 mm. long, lobes acute, 0.7-1.2 mm. wide, loosely connivent at maturity. Achene asymmetrically apiculate, 1.0-1.4 mm. long (usually 1.2 mm.), 0.65-1.0 mm. wide (usually 0.8 mm.), yellowish (somewhat immature but well developed achenes) to light pinkish-brown, the hilum somewhat protruding from the body of the achene, not flanged.

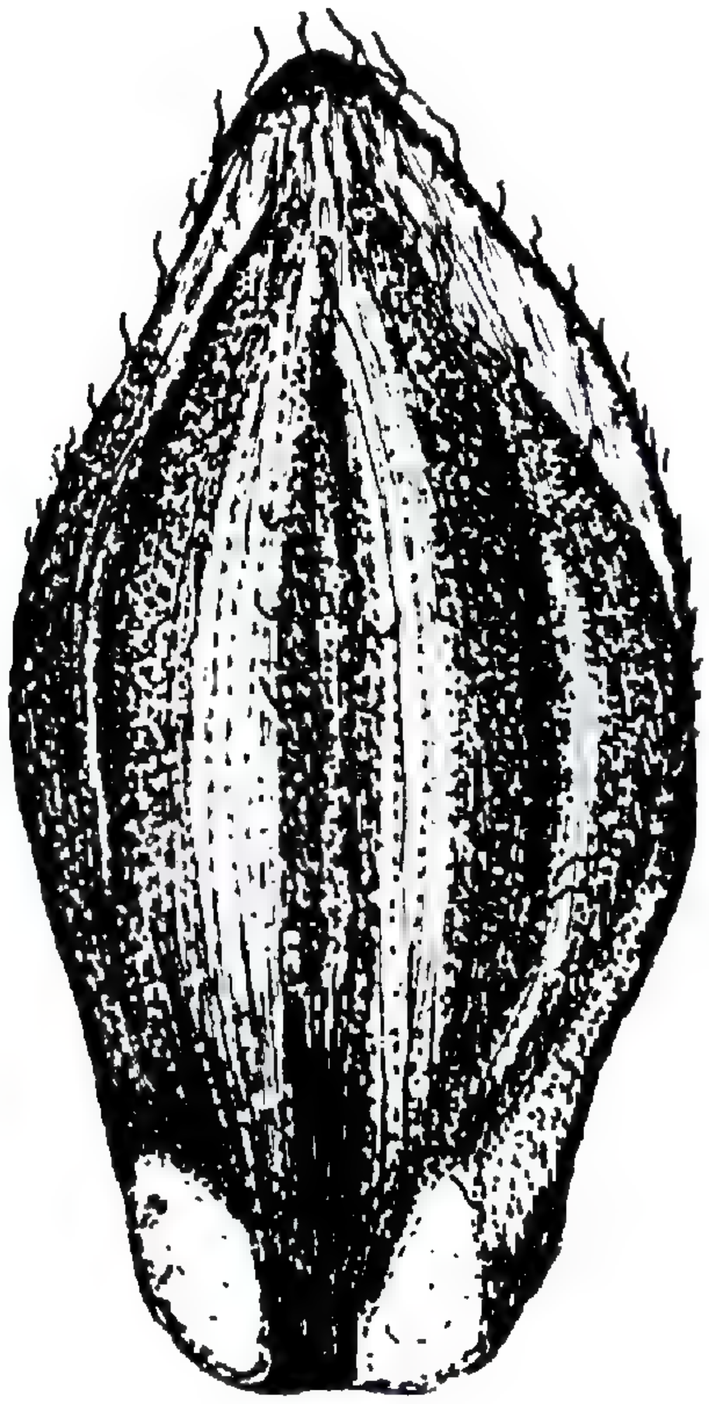
Herba annua prostrata ad erecta, radicibus fibrosis; folia petiolata; lamina deltoidea ad late ovata, basi palmatim 3-nervata, apice rotundata ad abrupte breviter acuminata, basi truncata ad obtusa vel rotundata; calyx 2.0-3.5 mm. longus, lobi 0.7-1.2 mm. lati, laxe conniventes ad maturitatem; achenia asymmetrice apiculata, 1.0-1.4 mm. longa, 0.65-1.0 mm. lata, luteola ad dilute subroseobrunnea, hilum aliquantum protrusum margine non annulatim incrassatum.

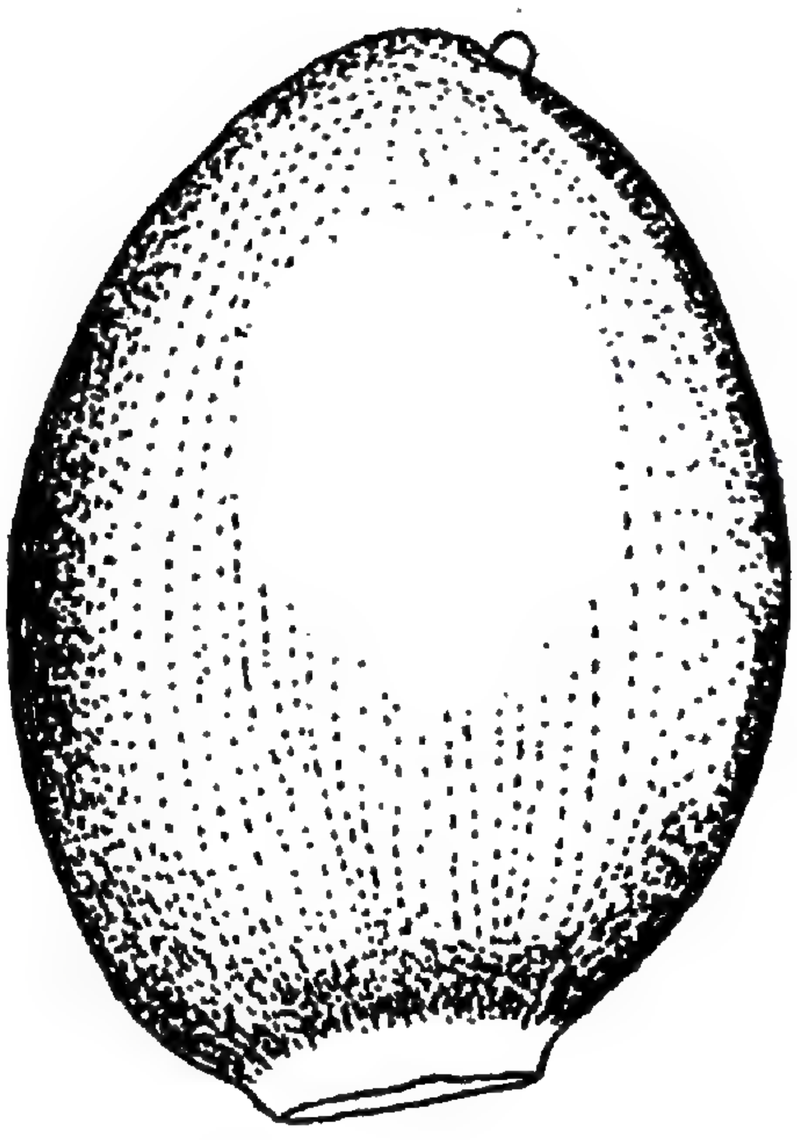
Holotype (GH): Florida. Merritt's Island. Feb. 1889, *Wm. Canby*.

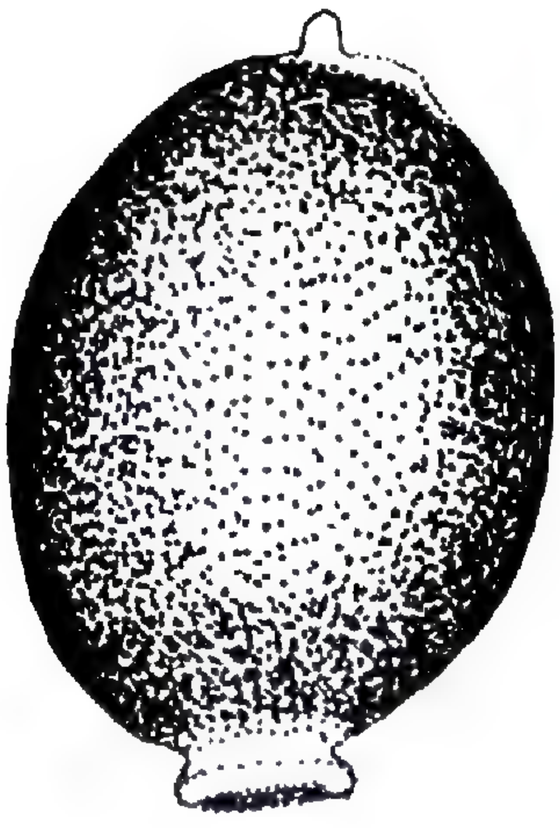
Parietaria praetermissa can be distinguished from *P. floridana*, the only other eastern North American species with palmately 3-veined leaves, as follows.

Achene without a flanged stipe, asymmetrically apiculate, usually longer than 1 mm. . . . . *P. praetermissa*

Fig. 1. *Parietaria praetermissa*: calyx in fruit (upper left) × 28; achene (lower left), × 50. *Parietaria floridana:* calyx in fruit (upper right), × 60; achene (lower right), × 60. Figures based on type specimens of these species.







Achene with a flanged stipe, symmetrically apiculate, usually shorter than 1 mm. ..... *P. floridana*

The name *P. debilis* Forst. f. has been applied incorrectly to *P. praetermissa* and *P. floridana*. *Parietaria debilis*, however, has symmetrically apiculate, unstiped achenes which are distinct from those of both *P. praetermissa* and *P. floridana*.

I am grateful to Dr. John W. Thieret for his guidance in the preparation of this paper and for his help with the Latin description. The following herbaria loaned the specimens used in my study: FLAS, FSU, GH, NCU, NY, PH, SMU, and US.

NOTES ON THE TEXAS ERIOGONUMS

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At the request of Dr. Donovan S. Correll and Dr. Marshall C. Johnston I prepared the treatment of the genus *Eriogonum* (Polygonaceae) for their forthcoming *Manual of the Vascular Plants of Texas*. As this treatment is floristic in nature and the style of presentation does not allow for discussion of the various taxa, this note is presented so that some comment on the species treatment might be made. During the course of this study 19 species have been found to occur in the state of Texas, with most of them restricted to the Trans-Pecos and Panhandle regions. The various species are discussed in the linear-arrangement which will be used in the *Manual*.

1. *Eriogonum alatum* Torr. In a recent unpublished doctoral dissertation, Dr. William J. Hess (1967), now of Western New Mexico University, has revised the species of the subgenus *Pterogonum* (H. Gross) Reveal. In the Texas flora, five of the eight species of this subgenus are found, and I have drawn freely from Hess's dissertation for the first five species in this treatment. The var. *alatum* is found only in western Texas in Brewster and Hudspeth counties, and extends northward to northwestern Nebraska and westward into southwestern Wyoming, eastern Utah and Arizona. Hess recognizes two additional varieties in *E. alatum*, the var. *mogollense* S. Stokes ex M. E. Jones of north-central Arizona and the var *glabriusculum* Torr. which occurs in the Panhandle of northern Texas eastward into central Oklahoma. The var. *glabriusculum* may be distinguished from var. *alatum* by its glabrous inflorescences and involucres. I have seen and collected specimens of this variety from Lubbock and Crosby counties northward.

The chromosome number of var. *alatum* is n = 20 (Reveal, 1967), and the same number may be reported for the var. *glabriusculum* based on *Reveal & Davidse 880*, Tule Canyon, Briscoe Co., Texas. Voucher specimens of all collections are deposited at Utah State University.

2. *Eriogonum nealleyi* Coult. In the subgenus *Pterogonum* this species may be quickly distinguished by its glabrous stems and inflorescences

[1] The field work was supported by a grant from the Texas Research Foundation for which I am grateful. The cooperation of Arthur H. Holmgren, Curator of the Intermountain Herbarium, Utah State University, is noted and my thanks are extended to Mr. Gerrit Davidse of that university who aided me with the field work. I wish to thank the Smithsonian Institution and the United States National Herbarium which sponsored my Predoctoral Internship program in Washington, D.C., from September 1966 to February 1967, where this paper was initiated. In the course of this study, collections from the following herbaria have been examined: BRY, GH, K, LL, LY, MO, NY, OKL, SMU, TAES, TEX, TTC, US, UTC. The illustration was drawn by Mrs. Twila D. Bird of Brigham Young University. The two papers associated with the Texas flora have been submitted to the Department of Botany at Brigham Young University as partial fulfillment of 2 hours of Special Problems given during the summer session of 1967.

and its strigose leaves. This species is known from small, widely scattered populations in central Texas, and rarely are there more than a few hundred plants at the various known stations. The Nealley type was said to have been collected in Pecos Co., but this site has not been relocated. Later collections have come from Reagan, Irion, Coke, Runnels, and Howard counties.

A chromosome count of n = 20 may be reported based on *Reveal & Davidse 901* from 16.2 miles east of Barnhart along U. S. Highway 67, Irion Co., Texas.

3. *Eriogonum hieracifolium* Benth. in DC. In Texas, this species is presently known from Brewster, Pecos, Jeff Davis, and Culberson counties, although I suspect that the plant should be found in the adjacent counties of western Texas. *Eriogonum pannosum* Woot. & Standl. from New Mexico is placed into synonymy, as the type of this species does not differ in any way from the isotypes of *E. hieracifolium* that I have seen. As shown by Hess, this species ranges from western Texas across central New Mexico into eastern Arizona.

A chromosome count of n = 20 has been based on *Reveal & Davidse 902* from 29 miles south of Fort Stockton along U. S. Highway 385 in Pecos Co.; 2.5 miles south of Kent along Texas Highway 118 in Jeff Davis Co., *Reveal & Davidse* 913; 27.5 miles southwest of White's City, New Mexico, along U. S. Highway 62-80, Culberson Co., Texas, *Reveal & Davidse 914*.

4. *Eriogonum hemipterum* (Torr. & Gray) S. Stokes. I. M. Johnston (1944) was the first to carefully discuss this species when he described the var. *griseum* from northern Coahuila and adjacent northeastern Chihuahua, Mexico. Nevertheless, Johnston's note that *E. hieracifolium* f. *atropurpureum* Standl. was referrable to *E. hemipterum* has been largely ignored. The var. *hemipterum* is restricted to the Chisos Mts., Brewster Co., and in the mountains immediately across the Rio Grande in extreme northeastern Coahuila, where it occurs in the oak and juniper forests.

I have counted one collection and found the chromosome number to be n = 20, based on *Reveal & Davidse 906* from the Chisos Mts.

5. *Eriogonum greggii* Torr. & Gray. This species is locally common on the high plains and grasslands of Nuevo Leon and Coahuila, Mexico, with one collection from La Jaiza, Hidalgo Co., Texas, which was collected by *E. J. Walker s.n.* (GH, TEX).

6. *Eriogonum longifolium* Nutt. One of the more complex species in Texas is *E. longifolium,* a member of the subgenus *Eriogonum.* Although much remains to be done on this species, I feel that the treatment to be used in the *Manual* is the most realistic considering the extremes in the species which may be seen throughout its entire range. With some difficulty it is possible to distinguish two varieties in Texas.

The var. *longifolium* extends from western Texas east to a vague line that runs from Grayson Co. south to around Bexar Co. This variety may be distinguished by its generally tomentose stems and leaves and inflorescences which are usually less than one-third the entire length of the plant, although the pubescence of all parts becomes less as one moves to the east and as the plants become taller. For the most part, the var. *longifolium* occurs on gypsum or limestone soils. The western form was described as *E. texanum* Coult. & Fish., non Scheele, which was later renamed *E. coriaceum* Coult. & Fish., but in my opinion, this is only an extremely reduced form of the var. *longifolium.* Additional synonyms of var. *longifolium* are *E. texanum* Scheele, and *E. longifolium* var. *lindheimeri* Gandg., var. *caput-felis* Gandg., and the ssp. *diffusum* S. Stokes.

The second variety which occurs in Texas extends from northern Arkansas and eastern Oklahoma into eastern Texas and western Louisiana where it extends as far south as the Houston area. This form may be known as var. *plantagineum* Engelm & Gray. It is distinguished by its longer leaves which are usually glabrous above and the upper stems and branches which are usually green and glabrous or nearly so. The inflorescences are highly branched and usually more than one-third the length of the plants. The var. *plantagineum* usually occurs in sandy soil on the edges of oak or pine forests. The recently described *E. vespinum* Shinners may be considered a synonym of var. *plantagineum.*

In reviewing the overall species, other taxa which seem to be only varietally distinct are var. **harperi** (Goodm.) Reveal, stat & comb. nov. (based on *E. harperi* Goodm., Bull. Torrey Bot. Club 74: 329. 1947) of Alabama and the var. *gnaphalifolium* Gandg. of central Florida. This latter plant has been called *E. floridanum* Small. Both of these varieties are distinguished by their large size and geographical distribution from var. *plantagineum* with some difficulty.[2]

It is possible to report that both the var. *longifolium* and the var. *plantagineum* have chromosome numbers of n = 20. Counts of var. *longifolium* have been made on the following populations: 4.5 miles east of Tascosa, Potter Co., Texas, *Reveal &. Davidse 876;* 2 miles north of Benjamin, Knox Co., Texas, *Reveal & Davidse 884*; 15 miles south of Claude, Armstrong Co., Texas, *Reveal & Davidse 877*; Steamboat Mts., Taylor Co., *Reveal & Davidse 885*; and, 2 miles west of Gay Hill, Washington Co., *Reveal & Davidse 896.* The counts of var. *plantagineum* were made on the following populations: 1 mile north of Hearne, Robertson

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[2] A recent examination of some type material of *Eriogonum longifolium* at the New York Botanical Garden and the Royal Botanical Garden at Kew points out a possible problem with regard to this species. A fragmented specimen at NY seems to be var. *plantagineum* while a second sheet and a collection at K seem to be var. *longifolium.* Nuttall did make two collections of this species, but until the type material at the British Museum can be critically examined, some question as to the exact identity of var. *longifolium* must remain.

Co., Texas, *Reveal & Davidse 893*; and, 12 miles south of College Station, *Reveal et al. 894.*

7. *Eriogonum jamesii* Benth. in DC. In Texas two forms of this species are found. The var. *jamesii* occurs in the western Panhandle of northern Texas and in the mountains of western Texas. The var. *undulatum* (Benth. in DC.) S. Stokes ex M. E. Jones is known in Texas only from the Chisos Mts., Brewster Co., although its overall range extends southward into northeastern Mexico. The var. *undulatum* may be distinguished from var. *jamesii* by its crispate leaves and the thinner aspects of the stems and branching, woody, caudices which form large spreading mats.

A chromosome count of n = 20 may be reported for the var. *jamesii* based on the following populations: 13 miles south of Buena Vista, Chaffee Co., Colorado, *Reveal & Davidse* 867; 8 miles east of Springer, Colfax Co., New Mexico, *Reveal & Davidse* 874; and, 4.5 miles east of Tascosa, Potter Co., Texas, *Reveal & Davidse 875*. A count of n = 20 was obtained from a single population of var. *undulatum* from Upper Green Gulch, Chisos Mts., Brewster Co., Texas, *Reveal & Davidse 907.*

8. *Eriogonum* **correllii** Reveal, sp. nov. Robusta perennis herba, (1) 2-4 dm. alta; laminae foliorum lanceolatae vel ± ellipticae, (2) 4-12 (15) cm. longae, 1-3.5 cm. latae, subtus albo-tomentosae, supra floccosae vel glabrae et viridis, petiolis (2) 4-10 cm. longis, tomentosis, basi expansa, petioli (5) 10-20 mm. longi, 8-15 mm. lati; caules tomentosi, 0.5-1.5 dm. alti, bracteis foliaceis, 1-4 cm. longis, 5-15 mm. latis, subtus albo-tomentosis, supra floccosis vel glabris et viridis; inflorescentiae cymosae, 5-15 cm. longae, tomentosae; involucra turbinata vel campanulata, 3-5 mm. longa, 2-4 mm. lata, exta tomentosa, intus glabrus, 5-7 -lobata, bracteolis linearis, 2.5-3.5 (4) mm. longis, pedicellis 2.5-4.5 mm. longis, sparse pubescentibus; perianthia stipitata, flava, (2-5) 3-7 mm. longa, extra sparsa pubescenta, intus glabra, segmentis dissimilibus, extris 2.5-4 mm. longis, intus 4-7 mm. longis; stamina 3-5 mm. longa, filamentis basi pilosis, antheris 0.5-0.8 mm. longis, oblongis; achaenia 3.5-5 mm. longa, sparse pubescentia. N = 20.

Robust perennial herbs from large, woody, gnarled, caudices; leaves basal, often on elongated branched caudices 1-5 cm. long, the leaf-blades lanceolate to ± elliptic, (2) 4-12 (15) cm. long, 1-3.5 cm. wide, densely white-tomentose below except for the obvious yellowish- or greenish-brown floccose to glabrous midveins, floccose to glabrous and green above, the leaf-margins entire, the petioles 4-10 cm. long, tomentose, the clasping petiole-bases (5) 10-20 mm. long, (5) 8-15 mm. wide, densely

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Fig. 1. Illustration of *Eriogonum correllii* showing (A) the entire plant, (B) an involucre with several flowers within it, (C) a single flower in anthesis, (D) a single flower in fruit, and (E) an achene.

C
B
A
E
D

white-tomentose without, light-brown to tan and glabrous within except for the margins which are fringed with short hairs at the bases in some and the matted tufts of tomentum at the apices; flowering stems tomentose, (1) 2-4 dm. high, stoutish; inflorescences cymose, trichotomous at the first node, dichotomous or rarely trichotomous above, 0.5-1.5 dm. long, the bracts foliaceous, similar to the leaves only considerably reduced, 1-4 cm. long, 5-15 mm. wide, ternate; involucres turbinate to campanulate, 3-5 mm. long, 2-4 mm. wide, densely tomentose without, glabrous within, 5-7-lobed, the teeth less than 0.5 mm. long, the bractlets linear, 2.5-3.5 (4) mm. long, densely hirsutulous with long white cells up to 0.8 mm. long, the pedicels 2.5-4.5 mm. long, sparsely pubescent with white or hyaline hairs up to 0.5 mm. long, becoming less abundant toward the stipitate bases, several-flowered; perianth greenish-yellow to sulfur-yellow, (2.5) 3-7 mm. long, on stipes 1-2 mm. long, the calyx-segments dissimilar especially in fruit, the outer segments in anthesis densely pubescent with long hyaline hairs mainly along the midribs and bases, 2.5-4 mm. long, in fruit the pubescence becomes less abundant with the segments 4-5 mm. long and up to 2 mm. wide, the inner segments in anthesis densely pubescent with long hyaline hairs, 4-5 mm. long, in fruit the pubescence becomes less abundant but more dense than that of the outer segments, becoming 4-7 mm. long and up to 3 mm. wide, the outer segments becoming reflexed about half their length in fruit so as to be spreading outward with the inner segments erect and enclosing the fruit; stamens 3-5 mm. long, exserted from the spreading flowers in anthesis, the filaments pilose at the bases with stiff horizontal hyaline cells, the anthers 0.5-0.8 mm. long, oblong, yellow, the pollen grain elliptical with a wide single furrow, golden-yellow; ovary greenish-yellow, sparsely pubescent at the apices and along the lower portions of the styles; achenes light brown to brown, 3.5-6 mm. long, sparsely pubescent at the 3-angled apices, the bases glabrous; embryo straight. N = 20.

TYPE: TEXAS: Armstrong Co.: 15 miles south of Claude along Texas Highway 284, on the upper breaks of Palo Duro Canyon of the Prairie Dog Town fork of the Red River, ca 200 to 400 m west of the highway and ca 5 to 25 m down the slope, associated with *Quercus* and *Juniperus*, elevation 3500 feet, 23 August 1967, *James L. Reveal & Gerrit Davidse 878* UTC! 34 isotypes will be distributed to major herbaria from UTC.

Representative specimens:

TEXAS: Armstrong Co.: 15 mi s of Claude, 10 Oct 1964, *Correll 30383* (LL); Palo Duro Canyon, Terrill Christian Figure Three Ranch, 12 Sep 1964, *Rowell 10657* (TTC). Briscoe Co.: 5.6 mi nw of Quitaque, 26 Sep. 1935, *Parks & Cory 17271, 17272* (TAES); 11 mi e of Silverton, 24 Aug 1967, *Reveal & Davidse 881* (UTC); 5 mi w. of Quitaque, 20 Jun 1945, *Whitehouse 10022* (SMU). Floyd Co.: Blanco Canyon, 30 May 1934, *Reed 3750* (TTC). Hardeman Co.: Medicine Mound: 21 Oct 1952, *Correll 15148*

(LL), 20 Jun 1945, *McVaugh 7220* (LL, SMU), 24 Aug 1967, *Reveal & Davidse 883* (UTC).

Eriogonum correllii, a new species of the subgenus *Oligogonum* Nutt., has been known in Texas for several years as *E. jamesii* var. *flavescens* S. Wats. However, the var. *flavescens* is known only from the west side of the Rocky Mountains, and even so, the form of *E. jamesii* that this new species comes closest to in its gross morphology is an undescribed form from the high mountains of south-central New Mexico. *Eriogonum correllii* differs from var. *flavescens* in the larger leaves and stature, in its large bracteate, compound inflorescence, large flowers and the outwardly reflexed calyx-segments in fruit. From the var. *neomexicanum*, the Texas species differs mainly in the same features as noted above except that the leaves of both are similar as far as size is concerned. Nevertheless, the leaves of *E. correllii* are densely tomentose below while those of the New Mexico form are less tomentose and much thinner than the thick leaves of the species.

The new species seems to be most closely related to *Eriogonum allenii* S. Wats, which is highly restricted to the shale outcrops in Virginia and West Virginia. There are several species found on the Appalachian shale slopes which seem to have closely related species near or in the Rocky Mountains. Four of the more characteristic shale slope endemics are *Eriogonum allenii*, *Trifolium virginicum* Small, *Oenothera argillicola* Mack., and *Senecio antennariifolius* Britt. In explaining this disjunction, it is often suggested that several species, including some of these endemics, were forced southward by advancing glaciers after occupying areas considerably further north, with the glaciers destroying the intermediate populations.

Although it would be unwise to make another generalization in regard to all of the Appalachian endemics, as far as *Eriogonum allenii* is concerned, it might be equally suggested that its ancestoral types moved eastward along a southern route from the southern end of the Rocky Mountains. As I have mentioned (Reveal, in press), it seems rather likely that the disjunct populations of *E. longifolium* Nutt. found from Texas to Florida could be explained by an eastward movement of the species across the Gulf Coast Plains and with the intermediate populations being ultimately destroyed by high water due to melting glaciers.

It is my belief that both *Eriogonum allenii* and *E. correllii* were derived from *E. jamesii* Benth. in DC. If this should be the case, then it may have been that *E. jamesii* was rather widely scattered from the southern Rocky Mountains across the southern tier of states to the low Appalachian Mountains. Then, as with *E. longifolium*, with the reduction of the interconnecting populations, the various isolated populations were able to evolve independently of each other into morphologically distinct, highly specialized, and uniquely isolated taxa.

The chromosome count reported here is based on *Reveal & Davidse*

878, 881, and *883.* A similar count has been determined for *E. allenii* (Sister Elizabeth Henry, Trinity College, Washington, D.C., pers. comm.).

The name is selected to commemorate the collector of the specimens which first drew my attention to the distinctiveness of the population, Dr. Donovan S. Correll of the Texas Research Foundation. Most of the specimens that I had seen before were merely in leaf or in very early anthesis, but the Correll specimens cited above were in full flower and its characteristics could be readily determined.

9. *Eriogonum lachnogynum* Torr. This species is infrequently found in the northern Panhandle region of Texas where it is distinctive and not confused with any other species in the state. I have seen specimens from as far south as Deaf Smith and Randall counties. This species, as well as those following except for the last four, belong to the subgenus *Eucycla* (Nutt.) Kuntze.

10. *Eriogonum havardii* S. Wats. Throughout most of its range in western Texas, this species has basal leaves which are 1-3 cm. long, however in northern Culberson and Hudspeth counties and adjacent southern New Mexico, the leaves may be up to 5 cm. long. This longer leafed form has been named *E. leucophyllum* Woot. & Standl., but no sharp distinction exists between these two extremes as all intermediate leaf sizes have been seen. In Texas, *E. havardii* is found in the mountains from Val Verde Co., north.

11. *Eriogonum fendlerianum* (Benth. in DC.) Small. To my knowledge this species has been collected only once in Texas, and then no exact location data were given. As recently discussed by Reveal (1968), this species ranges from southwestern Colorado and adjacent northern New Mexico across to near the Texas line in Quay Co., New Mexico. The only Texas collection was collected by Rammel (US). I suspect that the species is to be found on the western edge of the Texas Panhandle.

12. *Eriogonum wrightii* Torr. ex Benth. in DC. In Texas this species is represented by var. *wrightii*, and poses no real problem, although that can not be said for the rest of its range which extends to the Pacific coast in the mountain ranges of the deserts. This species may be readily found in the low mountains of western Texas growing with *E. tenellum.*

13. *Eriogonum suffruticosum* S. Wats. This species is possibly the most interesting of the Texas buckwheats. It flowers in late March and April, and the plants are in full fruit by May. The flowers soon fall after the fruits are mature. Yet, while in the process of flowering and fruiting, some unique modifications occur in the flower which are not seen in any other species. The calyx-segments are dissimilar. The outer segments are fan-shaped while the inner segments are narrowly oblanceolate. In anthesis the inner segments are turned over each other and thus hid from view because of the wider outer segments. However, as the fruit matures, it grows upwards and forces the inner segments upwards as these segments tightly enclose the fruit. At the same time the outer segments

now curve outwards exposing even more of the inner segments. Thus, the flower, when seen in anthesis looks totally different when seen in fruit.

As this species is exceedingly rare, I would like to document all of the collections that I have seen.[2]

TEXAS: Brewster Co.: Along the road to Agua Frio, 6 mi w of the Alpine-Terlingua road, 18 Apr. 1961, *Correll & Rollins 23642* (LL); Bofecillos Mts., 1883, *Havard s.n.* (GH), the holotype; 5 mi nw of Nine Points Mesa, *Muller 5197a, 5197b* (LL, NY, SMU). Jeff Davis Co.: 6.5 mi e of Agua Fria Ranch, 13 Apr 1936, *Parks & Cory 18552, 18554* (TAES).

14. *Eriogonum annuum* Nutt. and 15. *Eriogonum multiflorum* Benth. In the Texas flora it is impossible to discuss one of these species without mentioning the other. Both are the most frequently collected species in the state and collectively the most widely distributed species. Flowering specimens of *E. annuum* may be quickly distinguished from *E. multiflorum* by its obovate outer calyx-segments as the outer segments of the latter species are oblong-cordate. So distinctive are these two species that it is difficult to comprehend how flowering specimens have been misidentified. As several nonflowering specimens have been collected and as it is assumed that other nonflowering specimens will be collected in the future, several other morphological features may be used to distinguish the two species.

Characteristics	*E. annuum*	*E. multiflorum*
Stem tomentum	Whitish, felty	Whitish early, becoming green and brownish at maturity, not felty
Leaf shape	Oblong to oblanceolate	Lanceolate, oblanceolate, elliptic or ovate
Leaf tomentum	Densely white below, less so above	Brownish-white below, greenish above
Involucre size	(2) 2.5-4 mm. long, 2-2.5 mm. wide	2-2.5 mm. long and wide
Involucre tomentum	Densely white tomentose	Sparsely whitish-brown to brown tomentose to glabrous
Inflorenscences	Elongated with few, long branches, open	Compacted with several short branches
Flowering time	Mainly from May to Nov.	Mainly from August to Nov.

Although even some specimens may still not be identifiable, it is hoped that the above summary will be helpful. As the species tend to be weedy, and seem to be rapidly moving throughout the state, the geographical distribution in Texas will change over the years. At present, however, *E. annuum* is found throughout most of the state except along the immediate Gulf Coast Plains where *E. multiflorum* is most common.

[2] There are likely some additional collections at Sul Ross State College, Alpine, Texas, but an attempt to see material in this herbarium was denied by the curator.

Nevertheless, *E. multiflorum* is known to extend as far west as Val Verde Co. and as far northwest as Lynn Co.

A chromosome count of n = 20 may be reported for *Eriogonum annuum* based on the following populations: 5 miles west of Parnell, Hall Co., Texas, *Reveal & Davidse 882;* 3 miles east of Mason, Mason Co., Texas, *Reveal & Davidse 887;* L. B. Johnson's Ranch 16 miles east of Fredericksburg, Gillespie Co., Texas, *Reveal & Davidse 898.*

A chromosome count of n = 20 may be reported for *Eriogonum multiflorum* based on the following population: 9 miles southeast of Elgin, Bastrop Co., Texas, *Reveal & Davidse 897.*

16. *Eriogonum polycladon* Benth. in DC. This weedy species is presently known in Texas only from Jeff Davis and Hudspeth counties, but it should gradually spread through much of western Texas over the years. A member of the subgenus *Oregonium* (S. Wats.) Greene, it is the only annual species which has involucres appressed to the stems in the state.

17. *Eriogonum tenellum* Torr. The subgenus *Ganysma* (S. Wats.) Greene contains few perennials, yet those that are found in it are most interesting. In the Texas species of this subgenus, there is only one perennial, *E. tenellum,* and within it are two rather distinct varieties. The var. *tenellum* which is distinguished by its strictly basal leaves, occurs from eastern Colorado south along the extreme western edge of northern Texas into the low mountains of western Texas with a few scattered populations in the grasslands area of the Rio Grande basin. On the granitic outcrops of central Texas is the var. *ramosissimum* Benth. in DC. which has elliptic to deltoid leaves sheathing up the stems to 15 cm. I have seen specimens of this variety from Mason, Llano, Burnet, and Gillespie counties. In the low mountains of western Texas in Presidio, Brewster, Terrell, and Val Verde counties ,the var. *platyphyllum* (Torr. ex Benth. in DC.) Torr. is infrequently found. The leaves of this variety are ovate to orbicular and sheath up the stems to 20 cm. It is this variety that is mostly commonly encountered in northeastern Mexico.

18. *Eriogonum abertianum* Torr. Without a doubt the most variable and perplexing buckwheat in Texas is *E. abertianum.* As the species flowers during most of the year in the state, it is possible to find specimens which are hardly a centimeter high, while at a different time the same population may have plants that are over 4 dm. high. Likewise the amount of pubescence varies with the time of the year that the collections are made. In general the low plants occur in the spring and tend to be more villous, these gradually enlarge and become less pubescent. As with most annual buckwheats, it is possible to have two or more different flowering seasons of this species. In late March to early May, new plants may be found, and normally the same kind of plant may be found after the "rainy season" in late September and October. Some of

the early flowering plants may die, but a majority usually survive and grow to be fairly large and even somewhat woody. Although it is now impossible to make any positive statements in this regard, it seems that if the summer months are fairly wet, then the plants tend to be erect and branch at the top. However, if the summer months are fairly dry, then the plants tend to branch profusely at the base. Then, when one adds to this seasonal variation the effects of edaphic conditions, the problems multiply. On the more sandy, well drained soil, especially where some moisture is available, the plants tend to be larger and more robust with denser pubescence than might otherwise be found in plants in more adverse conditions.

Thus, in considering all of these variations, it is impossible for me to maintain any of the taxa that have been proposed. The species names, *E. cyclosepalum, lappulaceum,* and *pinetorum,* all proposed by E. L. Greene, and the various infraspecific combinations are all considered by me to be conspecific.

In Texas, *Eriogonum abertianum* occurs from Howard Co. westward into northern Mexico and adjacent New Mexico and Arizona.

19. *Eriogonum rotundifolium* Benth. in DC. This low, spreading, glabrous and glaucous, annual herb is common in disturbed areas in western Texas with two outlying populations in Knox Co. and Dimmit Co. *Eriogonum rotundifolium* var. *angustum* Goodm. is now reduced to synonymy under *E. rotundifolium* as the specimens upon which the name was based are simply late flowering plants of the species in which the flowers had not fully matured before the lateness of the season stopped the growth. Even so, there are a few, typical, fan-shaped fully developed flowers on those specimens cited as the type and paratype.

In summary, the *Eriogonum* flora in Texas is not extensive nor difficult to distinguish. For the most part the species are on the fringe of their overall range and thus the infraspecific problems often found elsewhere are normally not found here. It is hoped, however, that the treatment presented here will be helpful to those who will find an interesting buckwheat and would like to know more about it.

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SOME COMMENTS ON AMERICAN LESPEDEZAS (LEGUMINOSAE)

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In a previous paper (Clewell 1966a) I had presented evidence that the 11 native American species of *Lespedeza* Leguminosae are capable of hybridizing with each other whenever plants of two or more species occur sympatrically. Furthermore, in sympatric populations of moderate size, it is the rule, rather than the exception, that a few hybrids will be present. Thirty-three hybrid combinations were reported on the basis of examinations of natural populations and herbarium specimens. Nine of these combinations were confirmed by progeny tests and two by comparisons with artificial hybrids.

Among these 33 hybrid combinations, the evidence for one, *L. intermedia* × *virginica*, was listed as very tentative. These species are close morphologically, and no progeny tests were run or artificial hybrids produced to confirm the identity of the few specimens appearing to be this hybrid. On 15 November 1964 R. K. Godfrey and I collected several lespedezas in fruit along the borders of open, upland pine woods in Torreya State Park, Liberty County, in the Florida panhandle. Plants of *L. virginica* (L.) Britt. were common, and a few colonies of *L. intermedia* (S. Wats.) Britt. were observed. Certain plants (*Godfrey 65012 & Clewell*, in part, FSU) were difficult to identify, although they most closely resembled shade forms of *L. intermedia* seen elsewhere. They did not have the narrower, appressed-pubescent leaflets of *L. virginica*, and they possessed the longer stipules and shorter calyxes of another closely related species, *L. violacea* (L.) Pers. The latter species is rare in the Southeast and has not been reported from Florida. Nonetheless, the region in which we were collecting is well known for disjunct and endemic species.

To establish the identity of these plants a few seeds were removed and planted in a greenhouse in 1966 for a progeny test. Seven plants were grown to maturity, and shoots were collected from them in 1966 and 1967. None of the progeny possessed the elongate keels and other distinguishing characteristics of *L. violacea*. Two of the seven offspring possessed all of the characteristics of "typical" *L. virginica*, one was typically *L. intermedia*, and another fell within the range of variation of *L. intermedia* but tended towards *L. virginica*. The other three offspring were intermediate between *L. virginica* and *L. intermedia*. One of these three had some branches with leaves typical in shape and indu-

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ment of *L. virginica,* while other branches bore leaves typical of *L. intermedia.*

This progeny test establishes the identity of the plants at Torreya Park as *L. intermedia* × *virginica* and confirms that this hybrid combination does indeed exist in nature. I noted previously (Clewell 1966b) that offspring from hybrid lespedezas often fell within the gamut of variability of one or the other of the parental species involved. The present hybrid is no exception; four of seven offspring are identifiable as *L. intermedia* or *L. virginica.*

Besides the 33 hybrid combinations already noted (Clewell 1966a), one and perhaps a second can now be recognized. In 1966 I visited the U. S. National Herbarium and examined some lespedezas collected by Wolff in Bell County, Texas. Included were specimens of *L. repens* (L.) Bart., *L. texana* Britt., *L. virginica,* and one which in my opinion is undoubtedly the previously unreported hybrid, *L. texana* × *virginica.* This plant *(Wolff 871)* is morphologically intermediate between these species. Since *L. texana* and *L. repens* are close morphologically, the possibility arises that this hybrid is *L. repens* × *virginica.* This plant did not resemble the many collections I have made of *L. repens* × *virginica* in the Southeast. The other new hybrid combination, *L. repens* × *texana* (based on *Wolff 880),* remains tentative because of the morphological similarity of these species. These collections are notable in that plants of *L. texana* rarely grow sympatrically with the other lespedezas.

Since publishing county distribution maps of the American lespedezas (Clewell 1966a), I have examined additional specimens which represent state records or notable range modifications. They are as follows: *Lespedeza angustifolia* (Pursh) Ell.: Philadelphia Co., Pa., *Brinton* in 1893 (US). *Lespedeza capitata* Michx.: Coos Co., N. H., *Pease 29240* (NEBC); Johnson Co., Texas, *Palmer 6471* (US). *Lespedeza hirta* (L.) Hornem. subsp. *curtissii* Clewell: Baldwin Co., Ala., *Godfrey 65963* (FSU); Polk Co., Fla., *McFarlin* (FLAS). *Lespedeza procumbens* Michx.: Harris Co., Texas, *Hall* in 1872 (US). *Lespedeza violacea:* Colbert Co., Ala., Isely 3849 (US); Warren Co., Ky., *Burton 397* (US); Hillsborough Co., N. H., *Batchelder* in 1917 (NEBC); Addison Co., Vt., *Grout* in 1896 (NEBC). *Lespedeza stuevei* Nutt.: Putnam Co., Fla., *Laessle* in 1940 (FLAS); Windham Co., Vt., *Blanchard 8* (NEBC). *Lespedeza texana* Britt.: Garza Co., Texas, *Palmer* 250 (US). *Lespedeza angustifolia* X *virginica;* Leon Co., Fla., *Clewell 2379* (FSU). I had examined the McFarlin and Laessle collections in 1961 and had misidentified them as *L. hirta* subsp. *hirta* and *L. virginica,* respectively. Unfortunately, on published distribution maps these two taxa are shown to extend further south in Florida (Polk and Putnam Cos., respectively) than extant specimens warrant (Clewell 1966a, Figs. 5, 13).

While rummaging through the specimens of *L. intermedia* at the National Herbarium I discovered a photograph of a specimen in the

British Museum, *Clayton 174*. This collection serves as the type of the name, *L. frutescens* (L.) Britt. Because it is a type, I have been unable to obtain it on loan. There has been some doubt as to the identity of this specimen. If *Clayton 174* is identifiable with plants I have been calling *L. intermedia* (S. Wats.) Britt., then *L. frutescens* becomes the legitimate name of this species on the basis of priority. From the photograph I can say with near certainty that *Clayton 174* belongs to *L. violacea* (L.) Pers., both from its habit and from the presence of an elongate, delicate peduncle. Therefore, the question of the legitimacy of the name, *L. intermedia*, raised previously (Clewell 1966a, p. 381) is resolved in favor of *L. intermedia*.

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A REASSESSMENT OF LINUM RIGIDUM AND L. CARTERI (LINACEAE) IN FLORIDA[1]

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Endemic to southern Florida and separated by several hundred miles from their nearest relatives are two populations of the *Linum rigidum* complex, an assemblage of a dozen or more taxa found otherwise only in western North America. The two populations differ from each other in several ways, perhaps the most conspicuous being that one is essentially glabrous while the other is hirsutulous throughout. In a recent discussion of them (Rogers, 1963) they were designated as varieties of *L. rigidum*, a widespread plant of the Great Plains. Since that time two sorts of information have come to hand which indicate that this arrangemen could be improved upon. As at least two Floras are now being compiled which will include these plants, this appears to be desirable time to reconsider them.

First, I have now had the opportunity to examinme several thousand specimens of the *L. rigidum* complex and to come to some conclusions concerning the range of variability in the whole group as well as in *L. rigidum* itself. I find that the Florida plants most resemble *L. rigidum*, especially var. *berlandieri*, but that they differ in the general absence of red pigment in the corolla, the thicker-walled fruit with well-developed cartilaginous plates and, in the pubescent form, the smaller floral parts, as well as the pubescence. On morphological bases alone, it is probably an arbitrary decision as to whether we consider these plants as varieties or as a separate species. The continued treatment of them as varieties of *L. rigidum* has the merit of pointing up the relationship between the Florida and the Great Plains plants. It also has the purely taxonomic disadvantage of adding to the cumbersomeness of the taxonomy of *L. rigidum*, since several varieties have already been assigned to this species and other variants are known which may warrant some sort of formal recognition.

The second kind of information comes from chromosome studies (Mosquin and Hayley, 1967). Both Florida populations have been found to have n = 30, while the western plants examined, and a number of counts have now been made (Dillman, 1933; Ray, 1944; Osborne and Lewis, 1962; Rogers and Harris, 1966; Mosquin and Hayley, 1967; Harris, unpubl.), all possess n = 15. Further, Mosquin and Hayley (1967) find that the glabrous and pubescent plants possess genomes which differ only by a few translocations but are essentially similar and unquestionably closely allied.

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The tetraploid plants are related to and conceivably derived from plants such as *L. rigidum;* indeed the glabrous form is not greatly different from this putative ancestor. By itself it might not warrant formal segregation from *L. rigidum.* The inclusion of the more highly specialized pubescent form as a part of *L. rigidum* extends much too far for either accuracy or convenience, any but the most conservative species concept. The morphological differences, plus the genetic barrier erected by the polyploid condition, in addition to the geographical isolation, clearly warrant recognizing this, as Small did earlier (1905) as the separate species, *L. carteri.* The similarity of chromosome complements and the high degree of fertility in greenhouse crosses (Mosquin and Hayley, 1967) indicate that the glabrous and pubescent populations must be considered conspecific.

The following treatment, therefore, of these two taxa is more in line with our present knowledge of them.

LINUM CARTERI Small var. CARTERI, N.Y. Bot. Gard. Bull. 3: 424. 1905.

Cathartolinum carteri (Small) Small, N. Am. Fl. 25: 31. 1907.

Linum rigidum Pursh var. *carteri* (Small) Rogers, Brittonia 15: 101. 1963.

This is the pubescent plant, restricted to the vicinity of Miami, Dade County, Florida. Type: *Small & Carter 758*, in pinelands, between Cocoanut Grove and Cutler, Dade County, Florida (NY).

LINUM CARTERI var. **smallii** *Rogers*, var. nov. Plantae tetraploideae; caules glabri; petala 11.5-17 mm. longa; styli 5.1-9.1 mm. longi.

This is the glabrous plant, confined to Collier, Dade and Monroe Counties Florida. Type: *Small & DeWinkeler 9936*, between Everglade and Deep Lake, Collier County, Florida (US; isotypes DUKE, FLAS, GH, IND, MO, NCSC, NCU).

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THE GENUS PACHYSANDRA (BUXACEAE)[1]

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The genus *Pachysandra*, a member of the Boxwood Family (Buxaceae), is a small group of shrubs, subshrubs, and perennial herbs of relatively low stature. Of the four species currently recognized as comprising the genus, three are indigenous to eastern Asia, one to eastern North America.

Pachysandra was last treated monographically in 1859 by Baillon. At that time, three species were included in the genus, representing only two of those presently recognized. Since publication of Baillon's monograph, additional information concerning the genus has been limited to uncorrelated, often very brief, descriptions of the taxa as they were discovered. Consequently, no key to the infrageneric taxa exists that incorporates all known members of the group. It is apparent then that revision of the genus is necessary. The purpose of this paper is to present a more complete systematic treatment of *Pachysandra*.

The systematic treatment is based primarily upon characteristics of external morphology correlated with the geographical distribution of such morphological groups as were delimited. Morphological information was obtained from herbarium specimens representing the entire *Pachysandra* collections of 52 herbaria and from living specimens of *P. procumbens* and *P. terminalis*. Information concerning geographical distribution was derived from collection data accompanying herbarium specimens and from considerable field work with the indigenous American species.

HISTORY OF THE GENUS

The original account of *Pachysandra* as a genus was published in Michaux's *Flora Boreali-Americana* in 1803. The genus was based upon the single species, *Pachysandra procumbens*, published in the same work. The specimen upon which the type species is based was collected by Michaux during his travels across the western Allegheny Mountains and through Kentucky in the 1790's.

In 1845, Franz Phillip von Siebold and J. G. Zuccarini described a second species, *Pachysandra terminalis*. The original description was based upon material collected in Japan by Siebold.

Baillon, in 1859, removed three genera—*Buxus*, *Sarcococca* and *Pachysandra*, from the Euphorbiaceae and placed them in a newly established family, Buxaceae. The latter was distinguished from Euphorbiaceae on the basis of the position of the ovules. In his monograph of the Buxaceae,

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[1] Portion of a doctoral dissertation written at Vanderbilt University.

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Baillon described in considerable detail the morphology of the two species of *Pachysandra* known at that time, namely, *P. procumbens* and *P. terminalis*.

Pachysandra axillaris, the third species, was described as new by Adrien Franchet in 1889. The original description was based upon material collected by Delavay in western China, in the province of Yunnan.

A third Asiatic species, *Pachysandra stylosa*, was described in 1908 by S. T. Dunn. The original description was based upon material collected in Fukien, China, by native assistants to Dunn during an expedition to that province in 1905.

Léveillé, whose contribution to systematic botany is generally regarded as more fortuitous than analytical, described as new, *Pachysandra Bodinieri* in 1913 and *P. axillaris* Franch. var. *kouytchensis* the following year. Both names were subsequently relegated to the synonomy of *P. stylosa*.

In 1913, Hayata described *Pachysandra axillaris* var. *tricarpa* on the basis of material collected in Taiwan (Formosa).

The most recent treatment of *Pachysandra* is that of Handel-Mazzetti (1929-1937). This work, however, is neither comprehensive nor definitive. Of the species described to this time, only *P. axillaris* and *P. stylosa* are included. The work does include the description of a new variety, *P. stylosa* var. *glaberrima*.

GEOGRAPHICAL DISTRIBUTION OF THE GENUS

Representatives of the genus *Pachysandra* presently occur in eastern Asia and eastern North America in areas of vegetation commonly considered as major remnants of great mesophytic forests that had a relatively uniform and widespread distribution throughout the Northern Hemisphere during the Tertiary period. These two areas, lying between latitudes 30 and 50 degrees north, are very similar geographically and, according to geologists, are quite old. They have remained largely undisturbed by major geological changes since the close of the Paleozoic period and probably have not been submerged since the close of the Cretaceous (Li, 1952).

In 1840, Asa Gray called attention to the floristic similarity existing between these two disjunct areas and pointed out certain entities, mainly genera, common to both. Subsequently, the subject of eastern Asia-eastern North America floristic relationships attracted the attention of many botanists, particularly plant taxonomists and phytogeographers. As the flora of each of these two regions became better known, more genera were found to exhibit a strikingly similar disjunct distribution; and at present no less than 150 genera, including *Pachysandra*, are recognized as common to the two areas.

The Asiatic species of *Pachysandra* occur in China, Japan and in Taiwan (Map 1). *Pachysandra terminalis* occurs both in Japan and China,

but it is the only species of the genus native to Japan. Data accompanying herbarium specimens indicate that this species is distributed throughout the main island of Honshu and Hokkiado, usually occurring in mesophytic forests of mountainous regions. In China it occurs in the central provinces of Kansu, Chekiang, Shensi, Szechwan, Hupeh and Yunnan.

Pachysandra axillaris is known only from central and western Yunnan. It occurs at altitudes of 7,200 to 10,000 feet, usually on the slopes of ravines, at the foot of bluffs, and at the margins of thickets.

Pachysandra stylosa is widely distributed throughout China over areas of considerable relief and of climatic and ecologic diversity. It is known to occur in Fukien, Kiangsi, Kweichow, Yunnan, Hupeh, Szechwan and Taiwan (Formosa). It is regionally sympatric with *Pachysandra terminalis* in Hupeh and Szechwan. The habitat of *Pachysandra stylosa* is similar to that of the other species. It grows on the slopes of ravines and in shaded gorges.

The single American species, *Pachysandra procumbens,* is distributed from central Kentucky southward through central and eastern Tennessee and western North Carolina into Mississippi, Alabama and western Georgia. It also occurs in the Tunica Hills area of Louisiana and in Jackson County, Florida (Map 2). It is usually found in deciduous woods, most often on gentle to rather steep slopes of shaded ravines and generally near a small stream. The soil of these sites is frequently calcareous, a mixture of moist clay and chert with a circumneutral pH.

Braun (1950) considers *Pachysandra procumbens* a characteristic herbaceous plant of the Western Mesophytic Forest Region, an area having as its eastern boundary the western escarpment of the Cumberland and Allegheny Plateaus and as its western boundary the loess bluffs of the Mississippi River. She states that although commonly thought to be rare, it is an abundant plant of mesophytic woods of that region.

Pachysandra procumbens has been described as disjunct in rich woods of the Marianna Red Lands of northern Florida and of the Tunica Hills of southern Mississippi and adjacent northern Louisiana (Harper, 1914; Brown, 1938). Both areas represent Tertiary forest extensions and are very old geologically. *P. procumbens* also occurs in the Tennessee River hills of northeastern Mississippi, an area which is transitional between plateau and coastal plain.

In Tennessee, the species occurs only in the central and eastern part of the state. It has been reported from the vicinity of Memphis, but there is no specimen to support this record.

The presence of three Asiatic species of *Pachysandra* and the apparently relict one in the United States suggests that the genus may have evolved in Asia. Recent discovery of fossil pollen of *Pachysandra* in the Western United States is good evidence that the genus was more widely distributed during the geologic past.

Gray (1959, personal communication) and Wolfe (1959, personal communication) have reported the discovery of fossil *Pachysandra* pollen from Miocene (late Tertiary) deposits in Oregon. Wolfe reports fossil pollen from early Miocene sediments collected in the Clackamas River basin about 60 miles southeast of Portland. Here the associated flora is a very rich one, comparable to that of the present mixed mesophytic forests of eastern North America and eastern Asia. Wolfe also reports the finding of leaves of an extinct species of *Pachysandra* that he considers most similar to *P. procumbens.*

Even older records of *Pachysandra* were reported by Leopold (1959, personal communication) who found fossil pollen of *Pachysandra* in Upper Cretaceous sediments of southwestern Wyoming (Evanston formation) and also in the Lower and Middle Paleocene (Tertiary) of the Wyoming, North Dakota, South Dakota, and Montana areas (Ft. Union formation). She has found the microfossils to be extremely common in more recent sediments in the upper third of the Fort Union and in the lowermost Wasatch formation in the same area (Upper Paleocene and Lower Eocene) and states that they represent pollen of the *Pachysandra procumbens* type. Eocene sediments from various localities in Oregon and sediments of Oligocene and Miocene age from the central western states show no *Pachysandra* microfossils.

According to Leopold, pollen analyses of sediments deposited during the Paleocene and Eocene indicate that *Pachysandra* grew in association with species of *Sphagnum, Pinus, Sequoia, Zelkova, Ulmus, Carya, Juglans, Alnus, Nyssa, Schizandra, Betula, Corylus,* and *Platanus.* Many species within these genera are apparently most closely related to those now growing in the eastern United States and eastern Asia.

The absence of *Pachysandra* pollen in the Oligocene of the Rocky Mountain area suggests that at some time during the Eocene the genus disappeared from the Central West. Its departure was probably brought about by the increasing provinciality of the climate during the middle Tertiary. Instead of the regionally humid, very warm temperatures and subtropical conditions of the late Paleocene and early Eocene, the Oligocene was locally very dry with warm temperature conditions.

In Oregon, *Pachysandra* pollen is absent from the Eocene deposits but present in the Miocene deposits. This suggests that in the interval between the two periods the genus may have migrated from the Central West to Oregon where it was eventually eliminated.

The present localization of *Pachysandra* in the southeastern United States apparently resulted from its migration southward during the latter part of the Tertiary in response to the increasingly colder conditions. The uplift of the Rocky Mountains and the resulting increased aridity of the interior probably led to the segregation of communities on the basis of the moisture requirements of their constituent species and the retreat eastward of those with highest demands. This resulted in the localization

in the Appalachian Mountains and plateau regions of remnants of the mixed forests of the late Cenozoic. *Pachysandra* most likely was associated with these remnants which have survived the geological changes of the past few million years.

SYSTEMATIC TREATMENT

PACHYSANDRA Michx. Fl. Bor.-Amer. 2: 177. 1803. Type-species: *P. procumbens* Michx.

Erect, decumbent or prostrate shrubs, subshrubs or perennial herbs, usually from ligneous or fleshy rhizomes with fibrous roots. Stems branching sympodially. Pubescence of simple, uniseriate trichomes. Leaves evergreen or semi-evergreen, simple, alternate, exstipulate, petiolate, pinnately 3-nerved, the blades glabrate or pubescent, variously toothed, subdentate to nearly entire. Inflorescences spicate, axillary or terminal; flowers unisexual, apetalous. Staminate flowers 5-40, sessile, occupying the upper portion of the floral axis; sepals 4, decussate, imbricate, ciliate, subtended by a single ciliate, pubescent bract. Stamens 4, distinct; filaments long-exserted, attached to the receptacle around a central, rectangular nectary; anthers oblong-linear, rotund to sagittate in shape, dorsifixed, introrse, longitudinally dehiscent, the connective sometimes prolonged as an appendage; pollen spheroid, with a polygonal ornamentation. Pistillate flowers 1-7, pedicellate, sessile or subsessile, inserted below the staminate at the base of the floral axis, subtended by several (7-13) distinct, imbricate, herbaceous bracts; ovary superior, 3- or sometimes 2-carpellate, each carpel with 2 locules separated by a false partition, each locule containing a single pendent, anatropous ovule; styles 3, sometimes 2, subulate to linear, erect, becoming recurved in fruit; stigma linear or linear-lanceolate, papillose, usually sulcate, covering the inner surface of the style branches. Fruit capsular or baccate, indehiscent. Seed with or without a micropylar caruncle, trigonal, the smooth, glossy testa hard and dry at maturity, dark brown or black in color; endosperm whitish and oily; the embryo straight, the cotyledons considerably broader than the radicle.

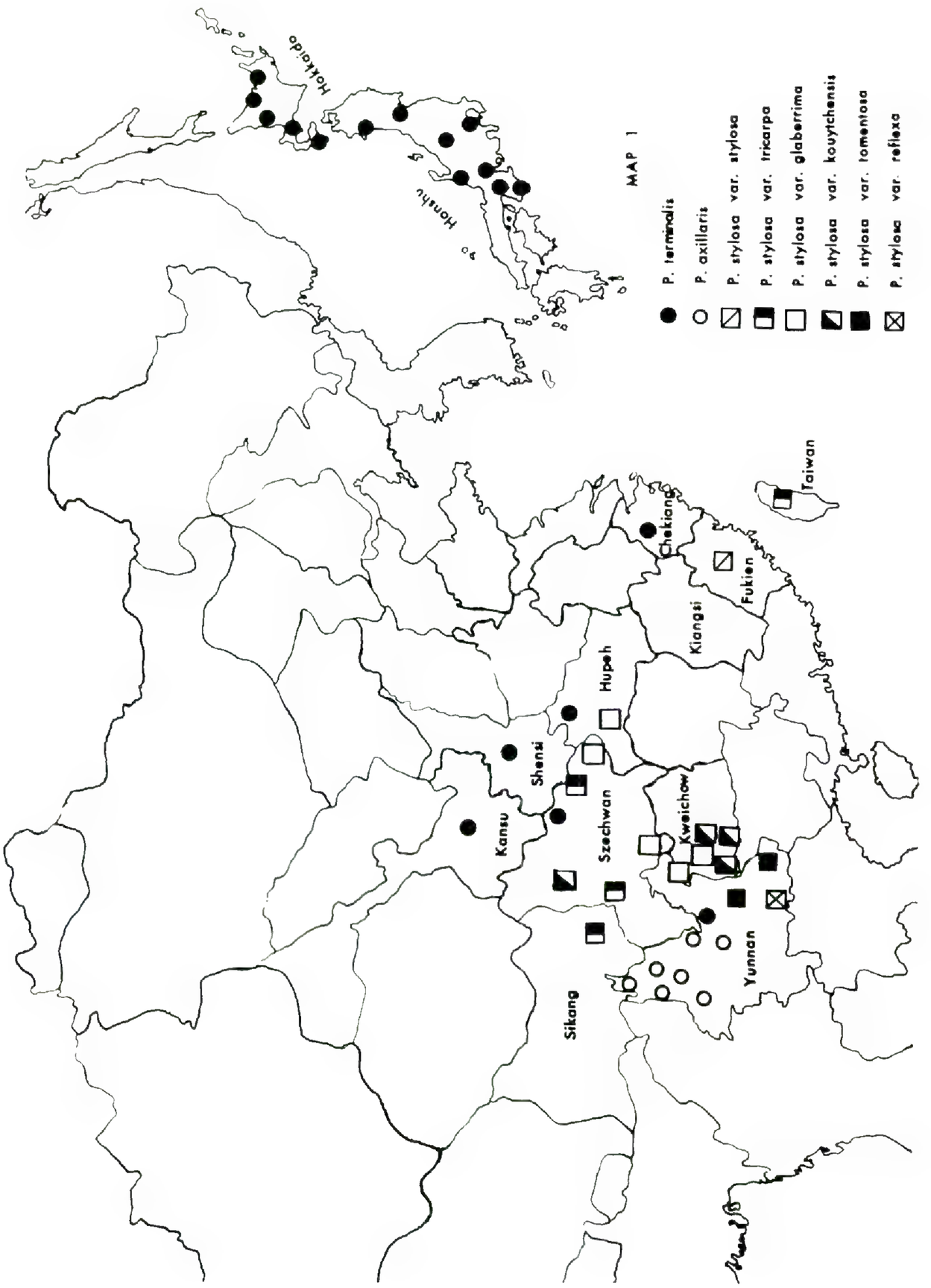
KEY TO THE SPECIES

A. Gynoecium two-carpellate; inflorescences terminal (Native to Japan, but found in China and Formosa). . . 1. *Pachysandra terminalis.*

A. Gynoecium three-carpellate; inflorescences lateral, arising from the aerial axis in a position axillary to basal bracts, their scars, or foliage leaves. . . . . B

B. Inflorescences usually basal to the aerial stem, subtended by bracts, only rarely by foliage leaves; filaments clavate; aerial stem and rhizome herbaceous; leaves semievergreen, becoming mottled in color in age; stem becoming procumbent in age. (North America). . . . . 2. *Pachysandra procumbens.*

B. Inflorescences axillary to foliage leaves; filaments linear, not con-


MAP 1
P. farmesii
P. axillaris
P. stylosa var. stylosa
P. stylosa var. tricarpa
P. stylosa var. glaberrima
P. stylosa var. kouytchensis
P. stylosa var. tomentosa
P. stylosa var. reflexa
Hokkaido
Honshu
Taiwan
Chekiang
Fukien
Kiangsi
Hupeh
Shensi
Kansu
Szechwan
Kweichow
Yunnan
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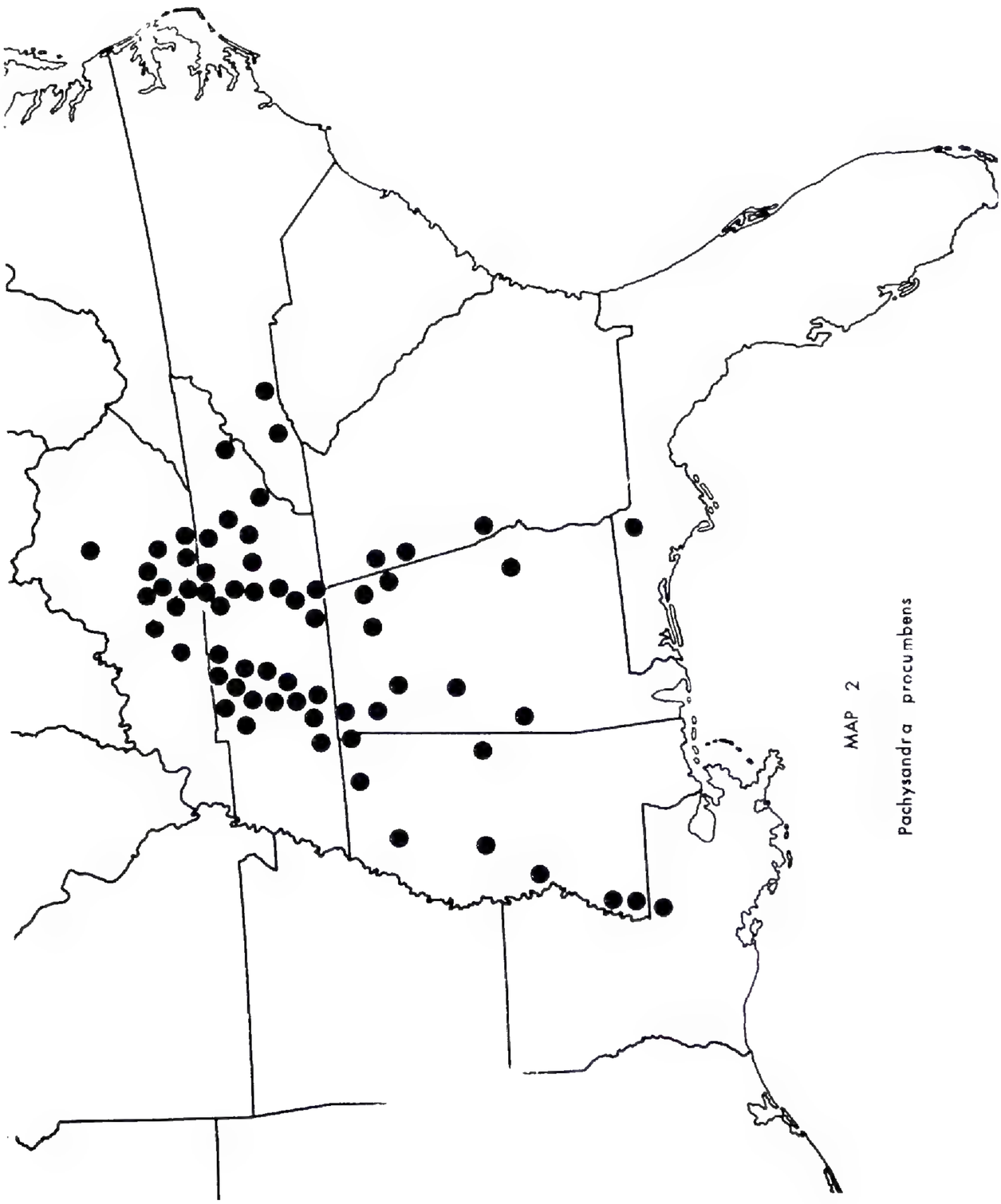

MAP 2

Pachysandra procumbens

spicuously clavate; aerial stem and rhizome ligneous; leaves evergreen; stem erect. C

C. Leaf blades coarsely dentate or distinctly serrate to crenate, ½ to ¾ of distal portion toothed, truncate to subcordate at the base, both surfaces beset with hair; marginal area of the lower surface usually densely hairy; the margin ciliate. (Yunnan, China) . . . . . 3. *Pachysandra axillaris.*

C. Leaf blades only sparsely dentate, subentire or rarely entire, ¼ to ½ of distal portion toothed, obtuse to oblique at the base, the upper surface glabrous, the margin eciliate (Widely distributed in China). . . . . 4. *Pachysandra stylosa.*

1. PACHYSANDRA PROCUMBENS Michx., Fl. Bor.-Am. 2: 177. 1803. "Hab. in occidentalibus montium Alleghanis." (P—Type, photograph examined). *Pachysandra erecta* Raf. ex Baillon: Monogr. Bux. et Stylocer., 1859.

Rhizomatous, colonial, herbaceous perennials with adventitious roots, the few to many, leafy aerial stems, 1.5-4 dm in height, becoming procumbent in age, persistent over winter and abscissing after anthesis. Rhizome subterete, 3-10 mm in diameter, white or occasionally tinged with pink, with numerous buds and bud scale scars. Aerial stem terete, 3.5-5 mm in diameter, 1.5-3 (-4) dm tall, unbranched, green in color, sometimes tinged with red, strigose, the trichomes increasing in number from the base upward to the leaves, upper portion foliate, lower portion naked or with short green to reddish bracts becoming brown and deciduous in age. Leaves (7-) 9-10 (-12) in number, approximate at the summit of the aerial stem, gradually diminishing in size upwards to the terminus of the stem, lowermost leaf blades (4-) 6-8 (-10) cm wide, membranous in texture, broadly ovate to obovate, dark green above becoming silvery mottled in age, dull green beneath, distinctly trinerved, the veins hispid, these prominent and depressed on the adaxial surface, the midrib and lateral veins prominent and elevated on the abaxial surface, the margin ciliate, the basal portion entire, acute or cuneate, becoming dentate to crenate toward the apex, the teeth nonapiculate, the petiole densely pubescent, the lowermost 2-5 cm long, one-third to one-half the length of the blade. Inflorescences basal to the aerial stem, (0-) 1-3 (-10) per shoot, spicate, cylindrical, 6-12 cm long, each with 18-38 staminate flowers and 1-3 (-7) pistillate flowers. Staminate flowers each subtended by a single, long-ciliate, broadly ovate, pubescent bract 2-3 mm long, 2.5-3 mm wide at the base, acute to acuminate at the apex; calyx of 4 subequal, ciliate, red to purple-tinged sepals, the outer two ovate, 3.5-4.5 mm long, 3-4 mm wide, acute at the apex, slightly keeled, with trichomes along the midrib, the inner two broadly ovate, concave, obtuse at the apex, retuse, glabrous, 3.5-4-5 mm long, 3-4 mm wide; stamens 8-13 mm long, 2-3 times as long as the sepals, with compressed-clavate, white, glabrous, fleshy filaments, 6-9 mm long, 1-2 mm

Fig. 1. *Pachysandra procumbens* Michx.

wide, tapering at the base, the elongate, minutely-apiculate, red to purple-tinged anther more or less deflexed at the connective at anthesis, 2-3.5 mm long, 1-1.5 mm wide. Pistillate flowers, each short-pedicellate to subsessile or sessile, the pedicel increasing in length from 6 mm at anthesis up to 13-16 mm in fruit, multibracteate, the lower bracts sub-triangular, concave to keeled, pubescent, 3-4 mm long, 2-3 mm wide at

the base, the apex acute, the upper 6-7 bracts ovate to elongate ovate, 3-4.5 mm long, 2.5-3 mm wide, the apex obtuse. Gynoecium 3-carpellate, shallowly tri-lobed, the pubescent, reddish green ovary 3-3.5 mm long, 2-2.5 mm in diameter; styles 3, erect to divergent, linear to lanceolate, 5-7 mm long, 2-2.5 mm broad, stigmatic surface sulcate, introrse, papillose. Fruit capsular, globose, 3-lobed, reddish brown in color, densely pubescent, styles persistent, becoming recurved when dry, 13-16 mm high, 8-12 mm in diameter when fresh, the carpels firmly united and never separating in drying but the whole fruit becoming detached at the base, falling off thus freeing the seeds. Seeds 3.5-4.5 mm long, 2-2.5 mm wide, glossy black in color, trigonous, carunculate.

Occurring chiefly on calcareous, clayey soils on the slopes of ravines in deciduous woods in central Kentucky, central and eastern Tennessee, western North Carolina, Alabama, Georgia, Mississippi, Jackson County, Florida and West Feliciana Parish, Louisiana.

KENTUCKY: Adair Co.: near Canoe Creek, rich woods, 10 mi n of Columbia, *Gibson* and *Watson 273* (F). Fayette Co.: banks of Raven Creek, *Shacklette, Rogers* and *Harvill 21* (DUKE, GA, GH, IND, MIN, MO, NA, NY, PH, TENN, UC, WVA). Jefferson Co.: Old Heady Road, 10 mi s. e. of Jeffersontown, April, 1964, *Robbins*. McCreary Co.: South Fork, Cumberland River, 5 April 1934, *Braun* (CINC, GH, NY). Pulaski Co.: 2 mi. n.e. of Somerset, *Wherry* and *Pennell 13766* (MO, PH). Taylor Co.: Dempsey Kerr farm, on creek bank, *Shacklette 14781* (SMU). Warren Co.: near Jackson Ridge, Gaspar River, *Thacher 391* (GH). Wayne Co.: s w of Monticello, Beaver Creek, *Hodgdon 3883* (GH).

NORTH CAROLINA: Polk Co.: near state Highway 108 at Green River, 8 April 1960, *Freeman 605* (personal collection—2 sheets).

TENNESSEE: Anderson Co.: Key Spring, n. of Oak Ridge, *Warren 20174* (TENN). Blount Co.: ¼ mi from Highway 73 near Walland, *Robbins* and *Channell 0063* (VDB). Cheatham Co.: wooded hillside, Little Marrowbone Creek vicinity, 6 April 1940, *Mortimer* (US). Cocke Co.: Wolf Creek, *Ruth 1182* (E). Cumberland Co.: River bluff, Harriman, 6 May 1945, *Cain* (TENN). Davidson Co.: Ravine in deciduous woods at the edge of Highland Rim, s w of Ridgetop, 29 Apr 1957, *Quarterman* (GH). Franklin Co.: Elk River, below Patterson's Bridge, *Svenson 7630* (BKL). Hardin Co.: along Steele Creek, e of Savannah, *Sharp, Clebsch & Fairchild 9483* (TENN). Hickman Co.: bluff and bottoms, near Dickson Co. line, Garner Creek Bridge, *Sharp et al. 11896* (TENN). Houston Co.: moist deciduous woods above Wells Creek, n of Erin, *Quarterman & Stauffer 4908* (VDB). Jackson Co.: Haydenburg, December 1922, collector not given (TENN). Lawrence Co.: near Fall River, along e fork of Sugar Creek, *Sharp et al. 9727* (TENN). Lewis Co.: bottoms and bluffs of Trace Creek near bridge on Tenn. Highway 48, s w of Hohenwald, *Sharp et al. 10096* (TENN). Maury Co.: ravine w of Rockdale, *Svenson 9041* (BKL, GH). Montgomery Co.: upper region of Macadoo Creek,

Clebsch & Brown 21551 (TENN). Morgan Co.: woods 2 mi n of Harriman, 5 April 1930, *Sharp* (GH). Pickett Co.: small cove on Dale Hollow Lake near camping area at Byrdstown Bridge, 18 March 1951, *Taylor* (NCU). Putnam Co.: Stamps Hollow, near Monterey, *Sharp 1710* (TENN, US). Roane Co.: Emory River bluffs, Harriman, *Underwood 2755* (TENN). Robertson Co.: Baker's Station, 23 March 1919, *Shaver* (PEABODY). Scott Co.: No Business Creek near South Fork River, *Shanks & Sharp 3870* (NY, TENN). Sumner Co.: South Tunnel, July 1883, *Gattinger* (GH). Van Buren Co.: near Cane Creek, Piney Creek Gulf, Fall Creek State Park, *Caplenor 566* (VDB). Wayne Co.: below Great Falls Dam, near Webb's Camp on Caney Fork, *Shanks et al. 5051* (TENN). William Co.: 7 mi s of Fernvale, ¼ mi from Highway 96, *Robbins 0002* (VDB).

ALABAMA: Cherokee Co.: 1.5 mi e of Forney, 15 July 1932, *Wherry* (NY). Franklin Co.: Russelville, December 1941, *James 4* (MO). Lauderdale Co.: Bat Cave, 2.5 mi n of St. Florian, 14 Mar 1953, *Chermock* (UA). Macon Co.: 1.5 mi n w of Hanna (Hannon?), 9 May 1929, *Wherry* (NY). Sumter Co.: York, 1 February 1934, *Bennett* (NA). Tuscaloosa Co.: w of North River, about 7 m n of Tuscaloosa, 23 March 1935, *Harper 3307* (BH, GH, MO, NY, PH, US).

GEORGIA: Floyd Co.: ex Herb. Chapman (MO). Haralson Co.: Tallapoosa, April-May 1900, *Way 42* (US). Harris Co.: along Standing Boy Creek, north of Columbus, 4 June 1949, *Duncan 9688* (GA).

MISSISSIPPI: Adams Co.: Natchez, 1843, distributed per P.V. LeRoy (MASS). Noxubee Co.: s e of Starkville in Bluff Lake area, 4 April 1959, *Beckett 76* (MISSA). Tippah Co.: 8 mi w of Ripley, May 1934, *Mellen* (MISSA). Tishomingo Co.: n of Eastport, n e of Iuka, 27 April 1952, *Schuster A-7377* (DUKE, FSU, MISSA, VDB). Wilkinson Co.: Tunica Hills, Pinckneyville, *Brown 7035* (LSU).

FLORIDA: Jackson Co.: Florida Caverns State Park, *Smith 3041* (GA).

LOUISIANA: West Feliciana Parish: 1 mi w of Plettenberg Post Office, *Correll & Correll 10451* (A, DUKE, F, LSU, MO, NA, NY, PH).

The taxonomy of *Pachysandra procumbens* is not complicated, being distinct morphologically and the only representative of the genus indigenous to North America. The herbaceous, procumbent habit, the basal position of the inflorescences and the semievergreen leaves are characteristic features of the species.

During the course of this investigation the specimens representing the disjunct Florida population of *Pachysandra procumbens* were compared morphologically with plants from other parts of the range. While in most cases the Florida plants were found to be smaller and with a less well-developed rhizome system, these variations are not considered to be of taxonomic significance.

Several anomalies were observed among both living and herbarium

specimens of *Pachysandra procumbens*. The incidence of these teratological forms seemed to be greater among those plants grown in the greenhouse or under cultivation than among those growing in their natural habitat. The most common deviation from the normal was the location of the inflorescences in the axils of the leaves and at the terminus of the aerial stem instead of the usual basal position. Several herbarium specimens of cultivated *P. procumbens* had many well-developed inflorescences in the axils of the foliage leaves. In one case, small leaves had developed in the place of the bracts of the staminate flowers. This ability of *P. procumbens* to produce inflorescences in the axils of leaves and at the terminus of the stem may represent the primitive condition with the basal position of the inflorescence being a derived condition.

Less clear significance can be attached to the presence of 2 or 4 styles in the pistillate flowers and 5 stamens in the staminate flowers. It may be that the 2-carpellate condition is derived and the 4-carpellate is more ancestral. The 4-style condition is not the ultimate since 5 stamens have been found.

The leaves of *Pachysandra procumbens* most closely resemble those of *P. axillaris*, being similar in texture, in the distribution of hair over the surface, as well as in the general shape and toothing of the blade.

Pachysandra procumbens frequently has been reported native to West Virginia (Gray, 1908), and in some manuals it has been listed as occurring in New Jersey. As far as I have been able to determine there are no specimens to substantiate these reports.

2. PACHYSANDRA TERMINALIS Sieb. and Zucc., Ahb. Akad. Muench. 4: 142. 1845. *Pachysandra terminalis* var. *variegata* (J.B.S. Nort.) Manning ex Hegi, Ill. Fl. Mittel-Eur. 5, 1: 203. 1924.

Rhizomatous, colonial, decumbent evergreen herbaceous perennials, with adventitious roots about 2 mm in diameter, the leafy aerial stems 1-3 dm in height. Rhizome fleshy, subterete, striate, 3-5 mm in diameter, with numerous leaf scars. Aerial stem simple or sparingly branched, olive green in color, grabrous or glabrate, terete, 3-5 mm in diameter, becoming angular when dried. Leaves in clusters of 5-9 at the summit of the stem and at intervals of 5-9 cm along the stem, the coriaceous, ovate to obovate, sometimes deltoid, cuneate blade, 5-7 cm long, 3-4 cm wide, glossy dark green above, pale green beneath, prominently 3-nerved, the veins puberulent, prominent and elevated on the adaxial surface, prominent but not elevated on the abaxial surface, the margin eciliate, the basal portion entire, becoming coarsely dentate to serrate toward the apex, the teeth deltoid, non-apiculate, the petiole canaliculate, glabrous, 1-3 cm long. Inflorescences terminal, solitary, spicate, cylindrical, 2-3 cm long, each with 15-20 staminate flowers above the 2-5 pistillate. Staminate flowers each subtended by a single, ciliate, coriaceous, triangular bract 1.5-2 mm long, 1.5-2 mm wide at the base, acute to acuminate at the apex and accompanied laterally by two opposite,

Fig. 2. *Pachysandra terminalis* Sieb. & Zucc.

acute to obtuse, concave, ciliate bracteoles, broadly ovate in outline, coriaceous in texture; calyx of 4 broadly ovate, concave, obtuse, ciliate

sepals 2.5-4 mm long, 2-2.5 mm wide; stamens 5-7 mm long with compressed clavate filaments 4-6 mm long, the linear or ovate, appendaged anthers 1.5-2 mm long, 1-1.5 mm wide becoming recurved after dehiscence. Pistillate flowers long-pedicellate, axillary to small reduced foliage leaves, the pedicel with many triangular to lanceolate, imbricate bracts. Gynoecium 2-carpellate, bilobed, the ovary 1-2 mm long, 1-1.5 mm in diameter; styles 2, divergent above, each 3.5-4.5 mm long, 0.5-1 mm broad, tapering upwards to a more or less blunt apex, stigmatic along the upper one-third. Fruit baccate, white and pulpy when fresh, bilobed, 6-7 mm long, 4-5 mm in diameter. Seeds 4-6 mm long, 2-3 mm broad, glossy brown to black in color, trigonal, apparently ecarunculate.

Abundant in deciduous woods at elevations between 3000 and 8000 feet; mountainous regions of northern Japan and north central China. (Map 1). Cultivated widely as an introduced ornamental in the cooler temperate regions of North America and Europe.

JAPAN: Honshu: at the foot of Mount Fugiyama, ex Herb. Lugd. Bat. (L); Sendai, July 1915, *Ken* (TI); in front of Buddhist temple, Gongen, Hakone, 20 May 1926, *Muramatsu* (TI); suburban area of Akita, 17 April 1928, *Muramatsu* (TI); Nikko in Shimotsuke, 19 May 1952, *Kubota*, distributed under no. 513, National Science Museum, Tokyo (BH, E, G, L, MO, NY, PH, UC, US); Kyoto, 5 April 1937, *Ohwi 9140* (GH, NA, UC); Mino Province, 25 May 1922, *Shiota 3005* (A); Numazawa in Uzen, 27 April 1946, *Okuyama* (BH); Lake Ashinoko, Hakone in Sagami, 8 October 1951, *Togazi*, distributed under no 385 by National Science Museum, Tokyo (L); Sagami, Mt. Hakone, June 1906, no collector indicated (E); Sagami, 3 October 1934, *Shiota 7947* (A); Sagami, Mt. Hakone, 20 May 1910, no collector indicated (US); Hakone, 26 May 1876, *Bisset 844* (E); Sagami, Hakone, 24 March 1910, *Sakurai* (E); in forest, altitude about 1000 meters, Kanagawa, 9 April 1950, *Suzuki* (UC, US); Kanagawa, 25 September 1949, *Suzuki* (A); Sagami, Mt. Hakone, 26 June 1911, no collector indicated (LD); Yezo, Kakomi, 1862, *Blake* (YU-2 sheets).

HOKKAIDO: Ishikari Mountain Range, Moiwa Yama, 19 May 1930, *Akiyama* (TI); Sapporo, 26 May 1887, *Tokubuchi* (PH); Mount Soranuma near Sapporo, June 1932, *Akiyama* (NY); Maruyama near Sapporo, 4 May 1907, *Takeda* (K); Sounkyo, 26 May 1952, *McClatchie 126a* (US); abundant in moist woods, Kitami province, 1914, *Wilson* (A); Muroran, 24 August 1905, *Jack* (A); along road in undergrowth near Nikoro, 24 September 1929, *Dorsett and Morse 1098* (A, GH, US); Hakodate, 1861, ex Herb horti bot. Petropolitani (FI, GH, L, M, NY, US); mountains northeast of Hakodate, 1853-1856, *Wright*, ex Herb. of the United States North Pacific Exploring Expedition (GH, US); summit of mountains northeast of Hakodate, in dense shade of trees and shrubs, 22 June 1855, *Wright* (L).

CHINA: SZECHWAN: District of Tchen-keou-tin, *Farges 198* (BM); 1885-1888, *Henry 6802a* (BM); ex Herb. M. de Coincy, *Farges* (K).

HUPEH: Specimens without definite locality: 1885-1888, *Henry 6802* (GH); 1885-1888, *Henry 5331* (NY); 1885-1888, *Henry 7836* (E, US); western Hupeh, *Wilson 438* (NY); 1885-1888, *Henry 4904* (E); woods, Fang Hsien, western Hupeh, alt. 5000-8000 feet, May-September 1907, *Wilson 303* (A-2 sheets, E-2 sheets, GH, US).

KANSU: Alpine woods above Chago, very common, 7000 feet, 6 May 1914, *Farrer* and *Purdom 48* (E).

CHEKIANG: Mount Hsi-tienmu-shan, 14 May 1935, *Migo* (A- ex Lingnan Univ. Herb).

SHENSI: Kian-san, 4 August 1877, *Giraldi 3504* (FI, K).

YUNNAN: 18 June 1887, *Delavay* 6389 (L); Yunnan-fu, June 1908, native collector (L).

Pachysandra terminalis is easily distinguished by the terminal position of the inflorescence and by the two-carpellate gynoecium. Other distinctive characters are: the elevated veins of the adaxial surface of the leaf blade; the smaller stigmatic area occupying only the distal one-third of the style branch; the presence of a coriaceous bract and two bracteoles subtending each staminate flower; and the elongate, multibracteate pedicel of the pistillate flowers. The baccate fruits are also unique.

According to information from herbarium labels, the white, berry-like fruits of *Pachysandra terminalis* are eaten by the natives in Japan and China. They have been described as having a decidedly sweet taste.

Siebold and Zuccarini, in their original description of *Pachysandra terminalis* in 1845, did not designate a nomenclatural type. I have thus selected a sheet from Zuccarini's Herbarium, now preserved at the Botanische Staatssammlung, Munich, to serve as lectotype. The following inscription, apparently in Zuccarini's handwriting, is found on the sheet: "Legit in Japonia, Communicavit de Siebold, anno 1842, *Pachysandra terminalis* S. & A." Four leafy axes, probably all from a single clone, comprise the sheet. One bears the number 3257 which is assumed to be the collection number. The following is good indirect evidence that this sheet was among the original material which served as the basis for the original description: First, these specimens are from Zuccarini's Herbarium; second, the determination was made in cooperation with Siebold; and third, the sheet bears the date 1842 which is three years prior to the date of publication of the original description of the species.

Comparison of specimens of *Pachysandra terminalis* from China with those from Japan showed no outstanding morphological differences. Although the leaves of the Chinese plants were generally smaller and the blades more deltoid and serrate than those from Japan, no taxonomic significance was attached to these differences.

Pachysandra terminalis has been used quite extensively as an orna-

mental since its introduction into the United States in the 1800's. The glossy evergreen leaves, its low creeping growth habit, and its extreme tolerance to shade make it an attractive ground cover, especially in shady places where grass is difficult to establish. It is also easily propagated from cuttings of both aerial stems and rootstocks.

Two specimens of the horticultural ornamental, *Pachysandra terminalis* Sieb. & Zucc. var. *variegata* Manning, were examined during the course of this study. These were leafy stems bearing neither flowers nor fruits. They were collected by Boom and bear the Lund Herbarium numbers 11996 and 14844, respectively. The leaves of the specimens are small, 3-5 cm long and 1-2 cm wide and the teeth are acute. Ivory white areas, confined chiefly to the margins, give a variegated appearance to the leaves. Although the original source from which the variegated material appeared is unknown, it is probably of clonal origin.

Following the International Code of Nomenclature for Cultivated Plants (Utrecht: Regnum Vegetabile, 1961), Article 15b, it seems best to refer to this cultivar as *Pachysandra terminalis* 'variegata', instead of *Pachysandra terminalis* var. *variegata*.

3. PACHYSANDRA AXILLARIS Franch., Plantae Delavay. 26: 135. 1889. "Yunnan, in silva Ta-long-tan, prope Tapintze, alt. 1800 m; 3 Mart. (Delavay, n. 1931)." (Type—P, photograph examined)

Erect suffrutescent subshrub, 3-4 dm in height, with a ligneous, rhizomatous rootstock, Aerial stems apparently annual, branching at the base, subterete, striate, 2-4 mm in diameter, stramineous when dried, hispidulous, the short stiff trichomes increasing in length and number upward to the distinctly petiolate leaves. Leaves (4-) 6-7 (-12) in number distributed at intervals of 1-3 cm along the upper half of the stem; blades submembranous to papyraceous, ovate to oblong-ovate, penninerved, 6-10 cm long, 3-6 cm wide, the basal ¼ to 1/3 entire, truncate to subcordate at the base, the apical 2/3 to ¾ crenate-serrate to serrate-dentate, acute to acuminate at the apex, the upper surface dark green and strigose with 3-4-celled, whitish trichomes becoming longer and more abundant near the margin, the midrib and laterals prominent but not elevated, the lower surface pale green and puberulous, the trichomes more abundant on the veins and margin, the midrib and laterals prominent and elevated, the margin ciliate; petioles noncanaliculate, puberulent, 2-4 cm long. Inflorescences axillary to foliage leaves, short-cylindric or globose, erect, each with (5-) 6-8 (-12) loosely arranged staminate flowers above the 1-3 pistillate flowers. Staminate flowers each subtended by a single ciliate, pubescent, triangular bract 1.5-2 mm long, 1 mm wide at the base, acute at the apex; calyx of 2 ovate, obtuse, ciliate, keeled outer sepals, 1.5-2.5 mm long, 1-1.5 mm wide and 2 broadly ovate, obtuse, ciliate inner sepals 2.5-3.5 mm long, 2-2.5 mm wide; stamens (5-) 7-9 (-12) mm long, 3-4 times the length of the sepals, with compressed-clavate filaments 5-8 mm long, the rotund to

Fig. 3. *Pachysandra axillaris* Franch.

elongate, nonapiculate anthers, 1-1.5 mm long, 1 mm wide. Pistillate flowers each subtended by 13-14 bracts, the basal one pubescent, 1.5-2

mm long, 1-1.5 mm wide at the base, with a thickened midrib, the succeeding 6, ovate, acuminate, 2-2.5 mm long, 1-1.5 mm wide, the upper 6-7, elliptic, ciliate, 2.5-3.5 mm long, 1-1.5 mm wide. Gynoecium 3-carpellate; styles 3, elongate, slightly divergent above, becoming strongly recurved in fruit, 4-11 mm long, the linear, sulcate stigma occupying the entire length of the style. Fruit capsular, yellowish brown to black when dry, trilobed, 6-7 mm long, to 7 mm in diameter. Seeds 4.5-5 mm long, 2.5-3 mm broad, glossy dark brown in color, trigonal, ecarunculate.

Known only from Yunnan, China where it occurs on wooded slopes of ravines and at the margins of thickets near streams at altitudes ranging from 7,200 to 10,000 feet. (Map 1).

CHINA: Yunnan. Without specific locality, no date given, *Delavay* (F, GH); Cool and shady places in gorges of Tsang-chan above Tali at 2300 meters altitude, 19 April 1887, *Delavay 2607* (A); ex Herbier de Pitard-Briau, no date given, *Delavay* (BM, E, G, GH-2 sheets); precise locality unknown, 4 September 1890, *Delavay* (E, GH, K, NY); Woods of Talong-tan near Tapintze, 10 November 1887, *Delavay* (E, K, NY); precise locality not given, 1 April 1889, *Delavay* (E, GH, NY); precise locality not given, 10 October 1889, *Delavay* (BM, NY); Bois de Talong-tan, pres Tapintze, 24 March 1890, *Delavay* (E); without precise locality, 28 June 1890, *Delavay* (G, GH, NY); Steep and wooded slopes of a ravine of a mountain near the College, vicinity of Yunnansen, 3 November 1899, *Bodinier 18D* (E); "Environs de Yunnan-sen", 3 November 1896, *Bodinier and Ducloux 18* (GH); Yunnanfu, *Ducloux 308* (E); at foot of cliff one-half way up mountain at La Kou, 2400 meters, November 1910, *Maire 3907B* (LA, NY, UC); *Maire 225* (GH); *Maire 304* (GH); cool and shady places in gorges of Tsong-chan above Tali, altitude 2300 meters, 19 April 1887, *Delavay 2607* (GH); north of Yunnanfu, 10 March 1914, *Schneider 322* (G); Salwin Valley, Lat. 28° N., 10,000 feet altitude, in thickets by streams, May 1918, *Forrest 16338* (E, K); at the foot of cliffs, April 19—, *Maire 238* (BM, E); vicinity of Yunnansen, no date given, *Maire 318* (BM, E); Tsongchan, *Ducloux 3610* (BM, E); western flanks of Mt. Tali Range, lat. 25° 40′ N., margins of thickets, no date given, *Forrest 15529* (BM, E); Siao-long-tan, no date given, *Maire 7154* (BM).

Most of the material examined in this study was collected by Delavay, a French missionary collector, during the years 1887-1890 in the vicinity of Tapintze northeast of Tali Lake in Western Yunnan. In this area, the species grows at altitudes of 7000-9000 feet on steep and wooded slopes of ravines and at the margins of thickets near streams.

Taxonomically, specimens of *Pachysandra axillaris* have been confused most frequently with those of the *P. stylosa* complex, probably because of the axillary position of the inflorescences which they have in common. The two groups may be separated on the basis of certain characters that are chiefly vegetative but nevertheless constant. Plants of

P. axillaris have regularly dentate or distinctly crenate to serrate leaves, while those of the *P. stylosa* complex are only sparsely dentate to subentire. The leaves of *P. axillaris* specimens are papyraceous or parchment-like to submembraneous in texture while those of *P. stylosa* are subcoriaceous to coriaceous. The leaf blades are usually truncate or subcordate in *P. axillaris*, while in *P. stylosa*, the blades, although highly variable, are usually rounded to obtuse or oblique, more commonly tapering into the petiole. Another character distinguishing *P. axillaris* from *P. stylosa* is the presence in the former of hairs on the upper surface of the leaves, concentrated in a zone on or near the margin, thus creating a ciliate or pubescent submarginal condition. The upper leaf surface of *P. stylosa* is glabrous, the margin eciliate. The pistillate flowers of *P. axillaris* are small, always sessile, with the style barely exserted beyond the calyx. The pistillate flowers of the *P. stylosa* complex are nearly always larger, subsessile to distinctly pedicellate, with long exserted styles.

There should be no difficulty in distinguishing *Pachysandra axillaris* from either *P. procumbens* or *P. terminalis* and little cause for confusing *P. axillaris* and the several varieties of *P. stylosa* with the possible exception of variety *tricarpa*. Although *P. stylosa* var. *tricarpa* shares the small, globose inflorescences in which the axis is equal to or less than the length of the filament, it may be clearly distinguished from *P. axillaris* by any one of the several characteristics enumerated below. There are usually 6-8 staminate flowers per inflorescence in *P. axillaris*. In *P. stylosa* var. *tricarpa* the number varies from 3-6. The leaf blades of *P. axillaris* are truncate to subcordate at the base while in *P. stylosa* var. *tricarpa* the base is rounded or oblique. The margin of the apical portion of the leaves is regularly dentate or serrate to crenate in *P. axillaris*. It is sparsely dentate in *P. stylosa* var. *tricarpa*. The upper surface of the leaf in *P. stylosa* var. *tricarpa* is glabrate and the margin eciliate. In *P. axillaris* the upper surface is strigose and the margin is ciliate. The petioles of *P. stylosa* var. *tricarpa* are canaliculate. Those of *P. axillaris* are noncanaliculate. *P. axillaris* is known only from central and western Yunnan. *P. stylosa* var. *tricarpa* occurs only in Sikang and Szechwan provinces.

4. PACHYSANDRA STYLOSA Dunn

The systematic treatment of the *Pachysandra stylosa* complex has proved to be problematical for various reasons. Lack of a sufficient number of representative specimens has made it difficult to provide a true picture of variation. Collections of *Pachysandra* from 52 herbaria have yielded approximately 65 sheets of *Pachysandra stylosa*, these representing less than twenty different stations. Many of the specimens were in poor condition or otherwise quite inadequate because of their fragmented condition. Of the available specimens, only 28 provided good floral structures. It has been necessary, therefore, to rely heavily upon

vegetative characters in defining the species on a morphological basis.

Interpretation of the *Pachysandra stylosa* complex from a geographical standpoint was hampered to a considerable degree both by the lack of sufficient collection data for some specimens and the obscure Chinese place names given as collection sites. Several of these names could not be located on present day maps because they were either English or French corruptions of the Chinese or were names of obscure villages or mountains.

The brief original description of *Pachysandra stylosa*, notably vague as to detail, in many ways is quite similar to that of *P. axillaris*. This, in addition to the atypical nature of the type specimen, has presented difficulty in the establishment of a clear concept of the taxon, *P. stylosa*.

The specimen upon which Dunn based the original description differs from the other specimens which I have associated with *Pachysandra stylosa*, particularly with respect to the height of the plant, size of the leaves and nature of the leaf margin. The plant from which the type was collected was a tree 6 feet tall, according to information on the herbarium sheet bearing it. Other representatives of this taxon are subshrubs that rarely exceed 14 inches in height. The leaf blades of the type specimen are 5-6 inches long, whereas those of the remaining *Pachysandra stylosa* specimens average 3-4 inches in length. The leaf margins of the type specimen are entire except for minute mucra toward the apex. In other specimens of the complex, a few leaves may be entire-margined but in no case are all the leaves entire. While the type specimen has more than 20 staminate flowers per inflorescence, the other specimens usually have less than twelve and, in many cases, less than six per inflorescence.

Comparison of staminate flowers was necessarily limited to the number per inflorescence and to the structure of the calyx, since no stamens were present on the type specimen. Use of the pedicellate nature of the pistillate flowers as a distinguishing character by Dunn is questioned by the present author because it has been found that, in some cases, even in *Pachysandra axillaris* and *P. procumbens*, a pistillate flower may become slightly pedicellate at maturity or in the process of fruit formation. The decidedly pedicellate nature of the pistillate flowers of the type specimen may be due to similar elongation following anthesis.

Specimens of *Pachysandra stylosa* frequently have been incorrectly determined as *P. axillaris*, apparently on the basis of the axillary position of the inflorescence alone. Many of these determinations were corrected by Handel-Mazzetti as indicated by his annotations of herbarium material. Apparently he has been the only one to recognize and annotate any specimens as *Pachysandra stylosa* since Dunn published the original description in 1908.

It has become necessary to broaden the original concept of *Pachysandra stylosa* due to the wide variability of the specimens which must

be associated with it. In this respect, the present author is in agreement with Handel-Mazzetti, who recognized specimens possessing a wide range of morphological variation as *P. stylosa*.

The *Pachysandra stylosa* complex, interpreted in a broad sense in this investigation, is highly variable, especially with respect to vegetative characters. This is not altogether surprising since the range of the species is so vast, covering areas exhibiting tremendous extremes in topography. Plants belonging to the *P. stylosa* complex are distinguished from other members of the genus by a combination of the following characteristics: inflorescences located in the axils of foliage leaves; leaf blades subentire or sparsely dentate, rarely entire, the base obtuse to oblique, the upper leaf surface glabrous, the margin eciliate; anthers usually apiculate not usually reflexed at anthesis; styles usually well-exserted at anthesis.

During the course of this investigation, herbarium specimens possessing these characteristics were brought together into one group. This assemblage was designated as the *Pachysandra stylosa* complex. In an effort to determine whether particular variations were constant and whether they segregated out on a geographical basis, the specimens were sorted into groups based upon morphological similarities and differences.

The resulting groups were then subjected to critical analyses in an attempt to determine constant characters that would serve to distinguish them. This included comparison of leaf size, length *vs.* width, shape and texture of blades; type and distribution of hairs on the leaves and stems; the form of the bracts and sepals of both staminate and pistillate flowers, including length *vs.* width and vascularization. Six morphological groups, each distinct with respect to certain characters and, in general, exhibiting allopatric distribution, became evident as a result of this process.

It is problematical how these groups, each comprised of less than 20 specimens, should be treated taxonomically. The paucity of specimens, lack of complete collection data, incomplete biological data, lack of information concerning breeding systems all make an adequate taxonomic disposition extremely difficult.

One alternative, which does not seem entirely satisfactory, would be to treat the members of each group as variants of *Pachysandra stylosa* and to describe the variations exhibited by each specimen individually. Since there are so many minor variations among the representatives of each group, it is feared that such a recourse would only add to the already existing confusion.

Another approach would be to name and describe each assemblage as a variety of *Pachysandra stylosa*. In view of the relatively good degree of morphological and geographical discontinuity, this method has been used in the present treatment. Because of the small number of

specimens available for study, the choice was made with some hesitation is available for analyses of variation and in which biological bepresent a more accurate picture of the existing situation in *Pachysandra stylosa*. Moreover, the varietal status would not inhibit the subsequent association of these varieties together as two or more subspecies. It is readily admitted that the establishment of the validity of these varieties as natural evolutional units will depend upon future investigations in which adequate material from throughout the broad range of distribution is avaliable for analyses of variation and in which biological behavior of the plants is incorporated. It is not impossible, on the other hand, that subsequent studies will produce information which will elevate some of these varieties to specific status.

KEY TO THE VARIETIES

A. Leaves entire (or with minute teeth at the apex); each inflorescence usually with more than 15 staminate flowers; a shrub up to 2 meters in height (Fukien). . . . . 4a. var. *stylosa*

A. Leaves subentire to sparsely dentate; each inflorescence with less than 15 staminate flowers; shrubs and subshrubs usually less than one-half meter in height. . . . . B

B. Length of leaf blade 2.5-3 times the width; teeth directed toward the base of the blade or laterally. . . . . 4b. var. *reflexa*

B. Length of leaf blade 1.5-2 times the width; teeth not directed toward the base of the blade or laterally. C

C. Leaf blades densely tomentose on the lower surface; thick, leathery in texture; petioles tomentose. . 4c. var. *tomentosa*

C. Leaf blades glabrous to minutely pubescent on the lower surface, membraneous, subcoriaceous to coriaceous; petioles glabrous to glabrate. . . . . D

D. Leaf blades membraneous, with soft grayish hair on the lower surface; usually with more than 12 staminate flowers per inflorescence. . . . . 4d. var. *kouytchensis*

D. Leaf blades coriaceous to subcoriaceous, the lower surface glabrous except for the minutely pubescent veins; usually with less than 12 staminate flowers per inflorescence. . E

E. Leaves ovate-oblong or elongated oblong, apex acute, abruptly acuminate or caudate, base rounded or suboblique; each inflorescence with less than 6 staminate flowers; each female flower subtended by 8-10 bracts. . . . . 4e. var. *tricarpa*

E. Leaves broadly ovate, apex obtuse or acute, base obtuse; each inflorescence with 8-12 staminate flowers; each female flower subtended by 12-13 bracts. . . . . 4f. var. *glaberrima*

4a. PACHYSANDRA STYLOSA Dunn var. STYLOSA.

Pachysandra stylosa Dunn. Journ. Bot. *46*: 326. 1908. "Deep gorge at

Fig. 4. Holotype of *Pachysandra stylosa* Dunn var. *stylosa*.

Tze Chuk Hang, Central Fukien, Dunn, May 30th, 1905, Hong Kong Herb. No. 3514." (Type—HK3514; Duplicates of the type: GH, K-photograph examined).

Erect shrub, up to 2 meters (?) in height. Aerial stem simple or branched, puberulent under 10X magnification, striate, terete, 3-4 mm in diameter, becoming angular when dried. Leaf blades coriaceous, ovate or elliptic, acute at the apex, obtuse at the base, 12-16 cm long, 6-11 cm wide, penninerved, the veins glabrous, prominent and slightly elevated on the abaxial surface, prominent but depressed on the adaxial surface, the margin eciliate, entire or with only minute teeth toward the apex, the petiole puberulent, 3-5 cm long. Inflorescences axillary to foliage leaves, lax and drooping in position, 2.5-3.5 cm long, each with 15-20 staminate flowers above the 2-4 pistillate flowers. Staminate flowers each subtended by a single, ciliate, broadly ovate bract 2.5-3 mm long, 2-2.5 mm wide at the base, acute at the apex; calyx of four elongate-ovate to oblong-obtuse, ciliate sepals 3.5-4 mm long, 2.5 mm wide, covered by numerous reddish brown spots. Pistillate flowers pedicellate, the puberulent pedicel 1.5-2 mm long, subtended by 10 bracts, the basal one elliptic to ovate, 1.5-2 mm long, 1.5 mm wide, the succeeding 4 elliptic to elongate ovate, reddish in color, 2.5-3.5 mm long, 2-2.5 mm wide, the upper 5, 4-5 mm long, 2.5 mm broad, oblong, obtuse, concave, ciliate, beset with reddish brown spots. Gynoecium 3-carpellate, styles 3, linear, 7-9 mm long, silghtly divergent, stigmatic surface introrse, sulcate, occupying the entire length of the style.

Known only from the type locality. Deep gorge at Tze Chuk Hang, Central Fukien, China. (Map 1).

CHINA: Fukien. Deep gorge at Tze Chuk Hang, *Dunn 1439* (HK—Holotype, GH—Isotype, K—Isotype, photograph examined).

No specimen examined during the course of this study was considered sufficiently similar to the type to warrant associating it with this variety. *Pachysandra stylosa* var. *stylosa* is therefore represented only by those specimens upon which Dunn based the original description of the species. These specimens were collected in a deep gorge in central Fukien by native collectors during Dunn's expedition to that province in 1905. As far as I have been able to determine, only 3 specimens are now in existence. Two of these, the type and an isotype, have been examined during the course of this study. A photograph of the second isotype has also been examined. These specimens leave much to be desired in that they are only portions of a plant and are in relatively poor condition. The leaves are broken and portions of them are missing. No stamens are present. The calyces of the staminate flowers, however, are intact. According to the collection data accompanying the herbarium sheets, the plant from which the specimens were collected was a tree 6 feet tall. This is almost 6 times the height of the tallest plants in the other varieties. For this reason, it is suggested that an error may exist in the collection data.

Fig. 5. *Pachysandra stylosa* Dunn var. *reflexa* var. nov.

The reputed size of the plants, plus the entire-margined leaves and the elongate, drooping, inflorescences bearing numerous staminate flowers are characters that distinguish this variety.

4b. PACHYSANDRA STYLOSA Dunn var. **reflexa** Robbins var. nov.

Laminae oblongo-ellipticae, 2.5-3 plo longiores quam latae, crasse dentatae. Apices dentium ad latum vel ad basin laminae versi. Filamentum antherae cristis papillosis parvis terminatum.

Erect subshrub, 2.5-5 dm in height with a ligneous, rhizomatous rootstock. Aerial stem simple or sympodially branched, subterere, striate, becoming angular when dried, 3-5 mm in diameter, with short, stiff trichomes. Leaves 4-7 in number, blades coriaceous, oblong to elliptic, penninerved, 11-15 cm long, 4.5-5 cm wide, the basal 1/3 to ½ entire, the apical ½ to 2/3 toothed, the apices of the teeth directed laterally or toward the base of the blade, the upper surface dark green and glabrous, the midrib and laterals prominent and depressed, the lower surface pale green and glabrous, the midrib and laterals prominent and slightly elevated, the margin eciliate, recurved; petioles glabrate, 3-4 cm long. Inflorescences axillary to foliage leaves, globose to elongate, 1-1.5 cm long, sessile to short pedunculate, each with 10-14 staminate flowers above the 1-2 pistillate flowers. Staminate flowers each subtended by a single, ciliate, pubescent, ovate to subtriangular bract, 1.5 mm long, 1 mm wide at the base, acute at the apex; calyx of 4 broadly ovate concave, obtuse, ciliate sepals, the outer two 2.5-3 mm long, the inner two 3.5-4 mm long, 2-2.5 mm wide; stamens 7-9 mm long, 2.2-2.5 times the length of the sepals, anthers 1.5-2 mm long, nonapiculate but with a tuft of minute papillae at the apex (under magnification). Pistillate flowers shortly pedicellate, each subtended by 10-11 bracts, the basal one broadly ovate to triangular, 1-1.5 mm long, 1 mm wide at the base with an acute apex, the succeeding 4-5 bracts ovate, acute, 1.5 mm long, 1 mm wide, with a prominent midrib, the upper 5 obtuse at the apex, 3 mm long, 1-1.5 mm broad, with a prominent midrib. Gynoecium 3-carpellate; styles 3, each 2 mm long, .5 mm broad, ovary 1 mm long. Fruits unknown.

Known only from the type locality, Yunnan; Mengtse. (Map 1).

CHINA: Yunnan: Mengtse, 6000 feet between Hsien Chen Kin and Tin Moko, *Henry 9959B* (US-Isotype, MO-Isotype, NY-Isotype, E-Holotype, K-Isotype).

Pachysandra stylosa var. *reflexa* is distinguished by the oblong to elliptic leaf blades with the length 2.3-3 times the width and the conspicuous lateral orientation of the apices of the teeth. Another distinctive feature of this variety is the presence of small tufts of papillae at the apices of the anthers.

Although the single collection of only 6 specimens leaves much to be desired, this element is so clearly and conspicuously marked morphologically by the reflexed teeth and the length *vs.* width ratio of the

blade that it would appear to deserve taxonomic designation. It may be argued that the description of the new variety on the basis of a single collection leaves everything to be desired from a biological point of view, yet I have been unable to equate or to reconcile the element represented with any other taxon. After careful consideration of all evidence, it appears that the logical thing to do is to establish a new variety.

4c. PACHYSANDRA STYLOSA Dunn var. **tomentosa** Robbins, var. nov.

Folia subtus manifeste tomentosa, pili longi multicellulares. Sepala exteriora lateralia florum staminatorum ad apicem crista pilorum multicellularium ad apicem.

Erect subshrub, 2-2.5 dm in height, with a ligneous, rhizomatous rootstock. Aerial stem terete, woody, 2.5-3 mm in diameter, simple or branching at the base, striate with numerous short stiff trichomes, increasing in number toward the summit. Leaves penninerved, 5-7 in number along the upper half of the aerial stem, decidedly coriaceous, the ovate to almost elliptic blades 7-10 cm long, 3.5-6 cm wide, dark green and glabrous above, pale green and densely woolly or tomentose beneath, the trichomes long and multicellular, each composed of elongate cells up to 8 in number, the veins prominent but depressed on the upper surface, the margin eciliate, recurved, the basal portion obtuse, entire, becoming subentire to sparsely dentate toward the apex, the teeth, when present, broad but not deeply cut, the petiole canaliculate, hispid, 2-4 cm long. Inflorescences axillary to foliage leaves, subsessile, 2-3 cm. long, each composed of 15-16 staminate above the pistillate flowers. Staminate flowers each subtended by a single short, subtriangular bract, acute at the apex and densely pubescent; calyx of 4 sepals, the outer two ovate, somewhat keeled, 2.5 mm long, 1.5 mm wide, with trichomes along the midrib and aggregated in a tuft at the apex, the inner sepals oblong to oblong-ovate, concave, 2.5 mm long, 2-2.5 mm wide at the base; stamens 6-7 mm long, twice the length of the sepals, with anthers 1.5-2 mm long, the connective projecting as an appendage. Pistillate flowers short-pedicellate, the pedicel multibracteate, the basal bract subtriangular, 1.5 mm long, 1 mm wide at the base, the succeeding 4-5 bracts elongate-ovate to lanceolate, 1.5-2 mm long with long trichomes on the outer surface, the upper 6-7 bracts elongate ovate to lanceolate, ciliate, concave, 2.5-3 mm long, 2-2.5 mm wide. Gynoecium 3-carpellate, styles 3, 3-6 mm long, slightly recurved, exserted beyond the calyx.

Known only from Yunnan, China.

CHINA: Yunnan. Lunan, date of collection not give, *Henry 9959A* (A—Holotype, E, MO—Isotype); Milet, date of collection not given, *Henry 9959* (MO, NY); Wenshan Hsien, woodland, altitude 2000 meters, 13 January 1933, *Tsai 51514* (A); Wenshan Hsien, on roadside, altitude 1600 meters, *Tsai 51605* (A).

Fig. 6. Holotype of *Pachysandra stylosa* Dunn var. *tomentosa* var. nov.

The morphological features by which *Pachysandra stylosa* var. *tomentosa* may be distinguished include: the conspicuously tomentose vesture of the lower leaf surfaces consisting of long, densely arranged,

multicellular hairs and the presence of a tuft of multicellular trichomes at the apex of the lateral, outer sepals of the staminate flowers.

As indicated in the citation of specimens examined, this variety has a very limited known distribution. Only six specimens were available for this study. These were collected in Yunnan, an area noted for a high degree of endemism.

4d. PACHYSANDRA STYLOSA Dunn var. **kouytchensis** (Léveillé) Robbins, comb. nov.

Pachysandra axillaris Franch. var. *kouytchensis* Léveillé. Fl. Kouytchéou p. 166. 1914.

Erect subshrub, 2-5 dm in height, with a ligneous, rhizomatous rootstock. Aerial stem ligneous, sympodially branched, terete, becoming angular when dried, 3-4 mm in diameter, dark reddish brown in color toward the summit, densely hairy with short stiff trichomes. Leaves 5-7 in number, blades submembraneous to papyraceous, broadly ovate, sometimes obovate or spatulate, trinerved, veiny, (5-) 7-8 (-11) cm. long, (3-) 5-6 cm. wide, the basal portion obtuse, sometimes cuneate, entire, the apical portion slightly dentate (sometimes distinctly dentate), the teeth minutely apiculate, the upper surface grayish olive-green and glabrous, the lower surface pale green with grayish, velvety pubescence, becoming glabrate in age, the lateral and tertiary veins prominent, and covered by soft, brown hair, the margin eciliate; petioles densely pubescent, 3.5-4 cm long, 1/3-½ the length of the blade, reddish brown in color when dried. Inflorescences axillary to foliage leaves, sessile, 2.5-3 cm long, each with 11-15 staminate flowers above the 1-3 pistillate flowers. Staminate flowers each subtended by a single, ciliate, pubescent, reddish, broadly ovate bract, 2-2.5 mm long, 1.5-2 mm wide at the base, acute at the apex; calyx of 4 subequal, oblong-ovate, concave, obtuse sepals, 3.5-4 mm long, 2-2.5 mm wide, each with reddish spots and a prominent midrib; stamens 9-10 mm long, the sagittate anthers 2.5 mm long, 1.5 mm wide at the base, apiculate, slightly deflexed. Pistillate flowers each subtended by 8-10 bracts, the basal one broadly ovate, 1-1.5 mm long, 1 mm wide at the base, acute at the apex, the succeeding 2-3, lanceolate, acute, ciliate, 3.5-4 mm long, 2-2.5 mm broad, the upper 5-6, lanceolate, ciliate, acute, concave, 4.5-5 mm long, 1.5-2 mm broad, each with 6-8 veins from the base, midrib prominent and pubescent. Gynoecium 3-carpellate; style 3, linear, nearly distinct, 6-7 mm long, stigma introrse, sulcate, occupying the entire inner surface of the style branch.

CHINA: KWEICHOW. Tsin-gay, date unknown, *Bodinier* (E—Holotype); vicinity of Kouyang, mountain at the College, 20 March 1898, *Chaffanjan 2186* (E); Kouyang, Tinfa, May 1902, *Cavalerie 1333* (E-3 sheets, K); Houangtsaopa, 1900-1920, *Cavalerie 7956* (E, K, UC). SZECHWAN. Kuan-hsien, 28 February 1937, *Chien 5828* (E); Kuan-hsien, 4

Fig. 7. Holotype of *Pachysandra stylosa* Dunn var. *kouytchensis* (Levl.) Robbins comb. nov.

April 1938, *Fan* and *Class 137* (A); Kuan-hsien, 6 July 1937, *Chien 5803* (E).

This taxon, first described as *Pachysandra axillaris* var. *kouytchensis* by Leveillé, subsequently was placed into synonomy with *Pachysandra stylosa* by Handel-Mazzetti. In the present work, variety *kouytchensis* of *P. axillaris* is treated as a variety of *P. stylosa.*

Pachysandra stylosa var. *kouytchensis,* although represented by rather variable specimens, may be distinguished on the basis of a combination of the following characters: the conspicuously long stamens with sagittate anthers; the elongate inflorescences and the lanceolate bracts of the pistillate flowers; by the submembraneous, veiny leaves, usually with soft, grayish green indument on the lower surface.

The shape of the leaf blade is often highly variable. The leaf blades of one specimen, *Chaffanjan 2186* (E), are oblanceolate to obovate-spatulate in outline. Four fragmentary specimens, collected by *Cavalerie 1333,* have highly variable leaves. In some cases there are broadly ovate and spatulate leaves on the same plant. Several dried fruits are present on two of the specimens. These are reddish brown in color and appear to have been pulpy in texture before drying. The herbarium label states that the fruits are eaten by natives.

4e. PACHYSANDRA STYLOSA Dunn var. **tricarpa** (Hayata) Robbins comb. nov.

Pachysandra axillaris Franch. var. *tricarpa* Hayata. Ic. Pl. Formosa. *3:* 171-172. 1913.

Pachysandra Borinieri Lev., Fedde Repert. 12: 187. 1913.

Erect subshrub 2-3 dm in height with a terete woody, rhizomatous rootstock. Aerial stem simple, sometimes branching sympodially near the base, woody, terete, glabrate. Leaves 6-7 in number clustered near the summit of the stem, the subcoriaceous, ovate-oblong or elongate-oblong blades 6-8 cm long, 3-4 cm wide, dark green in color and glabrate above, pale green and glabrate below, prominently penninerved, the lower surface with midrib and laterals elevated, the margin eciliate, involute, the basal portion rounded or more or less oblique, entire, becoming weakly dentate toward the acute, abruptly acuminate or caudate apex, the petiole canaliculate, 1.5-3 cm long. Inflorescences small, globose, axillary to foliage leaves, short-pedunculate to subsessile, 0.8-1.5 cm long, each with 3-6 staminate flowers above the 1-2 pistillate flowers. Staminate flowers each subtended by a single, subtriangular pubescent bract 1-2 mm long, 0.75-1.5 mm wide at the base, the margin ciliate, the apex acute; calyx of 4 decussately arranged, oblong, obtuse, concave sepals, each 2-3.5 mm long, 1-2.5 mm wide, obscurely 5-nerved; stamens 5-9 mm long, the apiculate anthers 1.5-2 mm long, 1-1.25 mm wide. Pistillate flowers subsessile, 5-6 mm long, subtended by 8-10 bracts, the basal one elongate, ovate, with an acute apex, the succeeding

Fig. 8. *Pachysandra stylosa* Dunn var. *tricarpa* (Hayata) Robbins comb. nov.

3-4 bracts, subequal, 1.5-2 mm long, 1-1.5 mm broad; the upper 4-5 bracts, elongate ovate, sometimes obovate, 4 mm long, 2 mm wide, concave, ciliate, the apex obtuse. Gynoecium 3-carpellate, styles 3, linear, 3.5-4 mm long, slightly recurved. Fruits pedicellate, capsular, 6 mm long, 7 mm in diameter. Seeds brown, 5 mm long, 3 mm wide.

Found in western and northeastern Szechwan, Sikang and Yunnan, China and Taiwan. (Map 1).

CHINA: Specimens without precise locality: Valley of Kiao-me-ti, alt. 3000 m, April 1913, *Maire* (E—2 sheets, G). SZECHWAN. Mt. Omei, 21 April 1932, *Yu 479* (GH); Mt. Omei, 14 April 1940, *Sun 1531* (US); Mt. Omei, October 1937, *Liu 1455* (A); *Omei Shan*, 21 August 1938, *Chiao* and *Fan 814* (A); Mt. Omei, 6 May 1940, *Sun 1859* (US); Mt. Omei, under woods, altitude 2400 meters, 21 April 1932, *Yu 481* (GH); Tchen-keou-tu (Chengkow?), *Farges* (A, BM, E, K, NY). TAIWAN. Tonkarankei, 16 April 1910, *Mori* (US-Holotype, photograph examined). YUNNAN. "Mont entre Ma Kay et Se-tchong-hsien, a' tien den Kiao", 3 April 1887, Bodinier (E). SIKANG. Near Tachienlu at 9,000-13,500 feet, *Pratt 796* (BM).

Pachysandra stylosa var. *tricarpa* is distinguished by the very small inflorescences, each usually consisting of less than six staminate flowers and with an axis shorter than the length of the stamens. Each pistillate flower is subtended by 8-10 bracts. The leaves are often long-acuminate or caudate.

This variety is most closely related to and most likely to be confused with *Pachysandra stylosa* var. *glaberrima* but differs from it primarily with respect to the number of staminate flowers and the number of bracts subtending the pistillate flowers. (See discussion of var. *glaberrima*).

Although originally described by Hayata as variety *tricarpa* of *Pachysandra axillaris*, the taxon is here transferred to *P. stylosa*. In making this transfer, it has been necessary to rely upon morphological evidence alone. Morphologically, variety *tricarpa* is more like *Pachysandra stylosa* than *P. axillaris*. The leaves are elliptic and sparsely dentate with ecilate margins and obtuse to oblique bases, characters, as has already been pointed out, by which *P. stylosa* and *P. axillaris* differ. It would appear that *P. axillaris* and *P. stylosa* var. *tricarpa* are too widely separated geographically for any genetic exchange to take place between them, whereas var. *tricarpa* is geographically close enough to other varieties of *P. stylosa* for such exchange to take place. (See Map 1).

4f. PACHYSANDRA STYLOSA Dunn var. GLABERRIMA Hand.-Mazz. Symb. Sinicae 7:236. 1929-1937. "Unter Strauchern in einem Graben bei Sanyingpan n. von Yunnanfu, 26°, Sandstein der wtp. St., 2400 m 14 III, 1914."

Erect subshrubs 1-3 dm in height with a terete woody, rhizomatous rootstock. Aerial stem terete, woody, 3 mm in diameter, simple or sym-

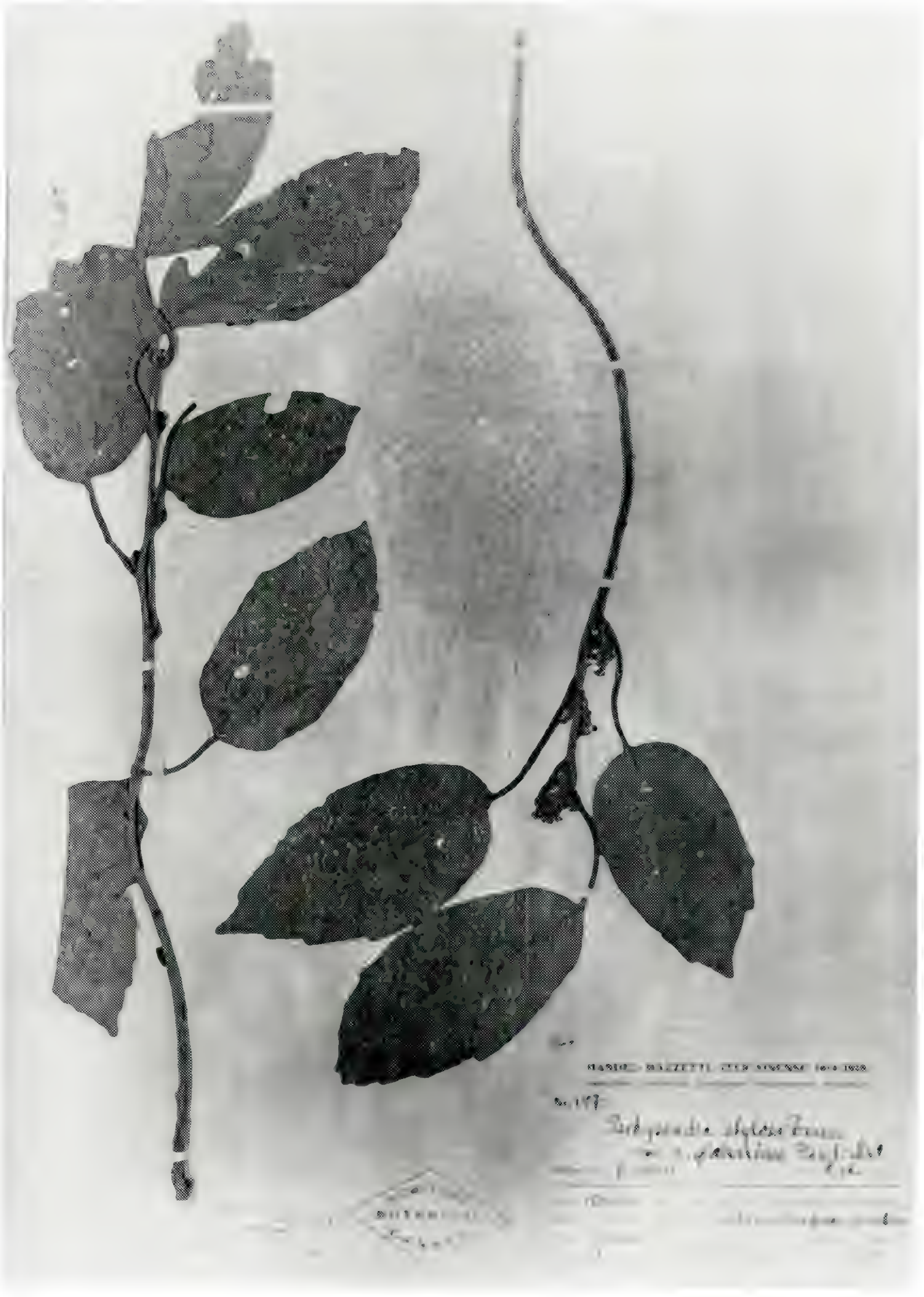

Fig. 9. Lectotype of *Pachysandra stylosa* Dunn var. *glaberrima* Hand.-Maz.

podially branched, glabrous to glabrate under magnification. Leaves 5-6 in number at the summit of the stem, subcoriaceous to coriaceous, the

elongate-ovate or elliptic-ovate blades 7-10 cm long, 3-5 cm wide, dark green and glabrous above, pale green and glabrous beneath, the mid-rib and lateral veins prominent, slightly elevated on the lower surface, terminating in apiculae at the margin, the margin eciliate, the basal portion rounded or obtuse, entire, becoming sparsely dentate toward the acute apex; the petioles canaliculate, glabrous, 3.5-4.5 cm long. Inflorescences axillary to foliage leaves, short-pedunculate to subsessile, 3-5 per shoot, 1-2 cm long, each composed of 6-10 staminate flowers above the 1-2 pistillate flowers. Staminate flowers each subtended by a single, ciliate, triangular bract, 2-2.5 mm long, 1.5-2.5 mm wide with an acute apex; calyx of 4 obtuse, concave, ciliate sepals, the outer two ovate and keeled, 3-4 mm long, 1.5-2 mm wide, the inner two broadly ovate, 3-3.5 mm long, 2-2.5 mm wide with approximately 7 nerves; stamens 5-8 mm long, 2.5 times the length of the sepals, with anthers 1.5-2 mm long, the connective projecting as an appendage. Pistillate flowers subsessile to sessile, 5-6 mm long, each subtended by 12-14 bracts, the basal one elongate ovate, 1.5 mm long, 1 mm wide, with an obtuse apex, the succeeding 5-6 subequal, 1.5-3 mm long, 1.5-2 mm broad, the upper 6-7, elongate-ovate, concave, ciliate, 3-3.5 mm long, 1.5-2 mm wide, with an obtuse or rounded apex. Gynoecium 3-carpellate; styles 3, reddish brown in color, recurved at the distal end, 4-7 mm long, 1-1.5 mm broad, usually 1.5-2 times the length of the sepals. Fruit reddish brown, short stipitate, 8-9 mm high, the persistent styles 11-12 mm long.

CHINA: YUNNAN. "Unter Strauchern in einem Graben n. von Yunnanfu, 26°, Sandstein der wtp. St., 2400 m., 14 III 1914, *Handel-Mazzetti 607* (A-2 sheets, E, NY-Lectotype, US); Sanyingpan, 14 March 1914, *Schneider 396* (A). KWEICHOW. Weining, in open hillsides, 17 October 1930, *Tsiang 9174* (A, BM, E, G); Langtai, on open hillsides, 5 November 1930, *Tsiang 9539* (NY, US). SZECHWAN. Without definite locality, 1885-88, *Henry 7529* (BM, GH); Without precise locality, 1885-88, *Henry 5589* (US); Wushan, 1885-88, *Henry 5709* (E, G, K, NY); HUPEH. Changyang, *Wilson 439* (NY); ex Hortorium Veitch, from Wilson's seed, 30 March 1907 (K). Without precise locality; Western China, no date, *Wilson 4451* (BM).

The original description of *Pachysandra stylosa* var. *glaberrima* is very brief, consisting of only three words: "Tota planta glaberrima", and is based upon a single collection. During the course of this study examination of at least five sheets of this collection, in addition to specimens accumulated since that time, has made it possible to expand the original description.

Handel-Mazzetti's number 607 at Arnold Arboretum has been taken to represent the type, although he did not designate it as such. The type locality, indicated as Sanyingpan, located north of Yunnanfu could not be located with certainty. Considering the fact that the Chinese prefix "*san*" means mountain and the suffix "*shan*" may also be interpreted as

mountain, it is possible that Yingpanshan, located north of the Yunnan border and northeast of Yunnanfu (Kunming) is the same as Sanying-pan and thus the actual type locality.

The leaves and stems of specimens of the type collection are strictly glabrous as also noted in Handel-Mazzetti's comments accompanying the original description. However, other specimens which I am associating with this variety, contrary to the connotation of the varietal epithet, possess sparse pubescence, not apparent to the naked eye but with 10X magnification. The trichomes are present along the midrib and lateral veins on the lower surface of leaf blades and also on the stems.

Pachysandra stylosa var. *glaberrima* is most closely related morphologically to *P. stylosa* var. *tricarpa*. These differ with respect to the number of staminate flowers and the number of bracts of the pistillate flowers. There are 6-10 staminate flowers per inflorescence and 12-14 bracts per pistillate flower in *P. stylosa* var. *glaberrima*. In *P. stylosa* var. *tricarpa* there are 3-6 staminate flowers per inflorescence and 8-10 bracts per pistillate flower.

The following is a list of herbaria from which *Pachysandra* specimens have been examined. The standardized herbarium abbreviations of Lanjouw and Stafleu (1959) have been adopted. An asterisk following an abbreviation denotes a herbarium not in their list.

A	Arnold Arboretum, Harvard University
BH	Bailey Hortorium, Cornell University
BKL	Brooklyn Botanic Garden
BM	British Museum (Natural History)
CINC	University of Cincinnati
CM	Carnegie Institute, Pittsburgh
DUKE	Duke University
E	Royal Botanic Garden, Edinburgh
F	Chicago Natural History Museum
FI	Herbarium Universitatis Florentinae
FLAS	Agricultural Experiment Station, University of Florida
FSU	Florida State University
G	Conservatoire et Jardin Botaniques, Geneva
GA	University of Georgia
GH	Gray Herbarium, Harvard University
HK	Herbarium, Gardens Department, Hong Kong
ILL	University of Illinois
IND	Indiana University
K	Royal Botanic Garden, Kew
L	Rijksherbarium, Leiden
LA	University of California, Los Angeles
LD	Botanical Museum and Herbarium, Lund
LSU	Louisiana State University
M	Botanische Staatssammlung, München

MASS	University of Massachusetts
MICH	University of Michigan
MISSA	Mississippi State University
MO	Missouri Botanical Garden
MOAR	Morris Arboretum, University of Pennsylvania
MSC	Michigan State University
NA	United States National Arboretum
NCU	University of North Carolina
NO	Tulane University, New Orleans
NY	New York Botanical Garden
OS	Ohio State University
OSC	Oregon State College
P	Museum National d'Histoire Naturelle, Paris
PAC	Pennsylvania State University
PBDY*	George Peabody College, Nashville
PH	Academy of Natural Sciences, Philadelphia
POM	Pomona College
SMU	Southern Methodist University
TENN	University of Tennessee
TI	Botanical Institute, University of Tokyo
UA*	University of Alabama
UC	University of California, Berkeley
US	United States National Museum
VDB	Vanderbilt University
WS	State College of Washington
WVA	West Virginia University
YU	Yale University

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A NEW SPECIES OF GALIUM (RUBIACEAE) FROM TEXAS

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ABSTRACT. A new diploid species from Texas is described, *Galium correllii* (Rubiaceae), with figures showing some morphological details.

The following new species of *Galium*, specimens of which were sent to me by Donovan S. Correll, has no close relatives that I have been able to discover. Dr. Correll collected it in flower on May 9, 1967, and at his request it was collected in fruit on July 13, 1967, by John Crutchfield and Richard Mitchell (*3393*). So far as is known, it occurs only in one canyon, described thus by Dr. Mitchell: "a single V-shaped canyon about 300 feet long. Water seeps through cracks, and channels the rocks in a peculiar fashion; the *Galium* is pendulous from the overhanging ledges. The fruit . . . is a juicy berry of purple-maroon color and is shaped like a football . . .". Dr. Correll writes that "there were a dozen or so plants 'plastered' to the surface of an overhanging cliff", and "growing in clumps or often pendulous sprays."

It is with pleasure that I name this interesting new species for its discoverer.

GALIUM **correllii** Dempster sp. nov.

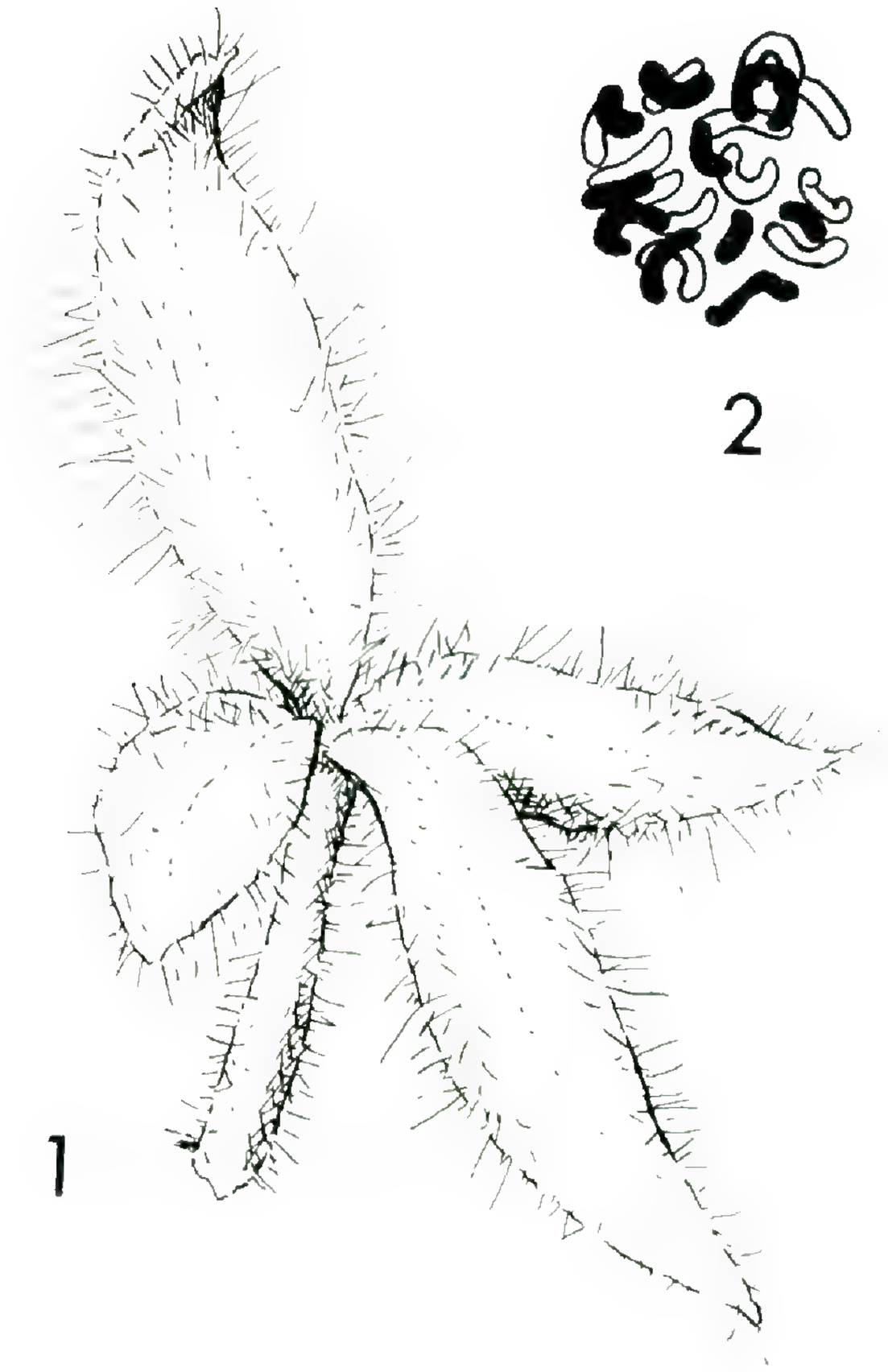
Plantae perennes humiles hirsutae, cespitosae vel e fissuras petrarum pendentes. Nodi quadrifolii, foliis lanceolatis apicibus attenuatis. Flores perfecti, corollis campanulatis lacteis purpureotinctis. Fructus glabri ellipsoidei carnosuli atropurpurei. Chromosomata 22.

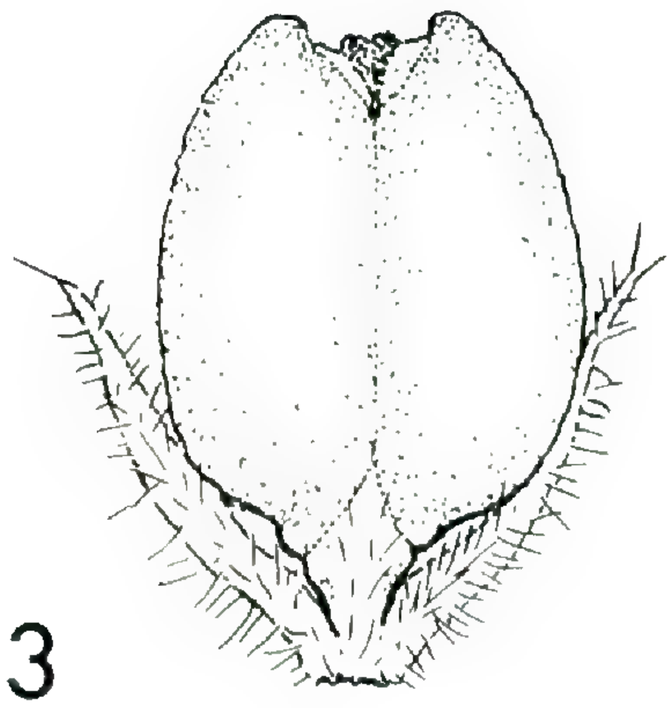
Type: Eagle Nest (Langtry) Canyon, east edge of Langtry, Val Verde Co., Texas, *D. S. Correll 34155* (UC 1324395, isotype LL).

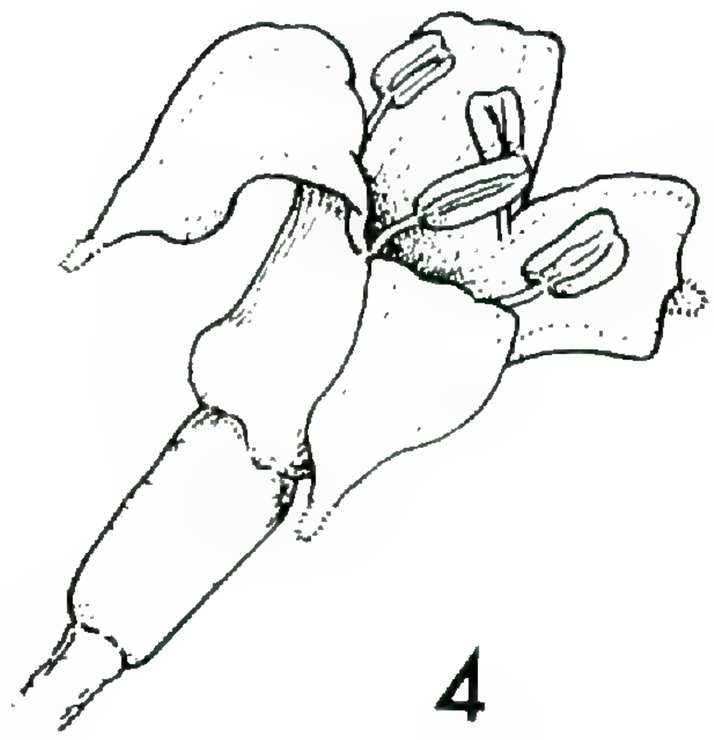
Small, gray-green matted perennials, woody only at base. Stems and leaves densely hispid with spreading hairs. Nodes about as long as leaves, or sometimes a little longer. Leaves 4 to a node, the true leaves a little larger than the stipules, commonly 4 to 6 mm long, sessile, broadly lanceolate, 1-nerved, drawn to a delicate point tipped with one or more long slender hairs, both surfaces with stomata; steroid cells absent. Flowers perfect, very short-pedunculate above a pair of reduced leaves. Corollas white or creamy, tinged with purple, campanulate, the tube about 1 mm long, the lobes a little longer, papillose, especially at tips. Ovaries oblong, minutely papillose. Fruits a little fleshy, ellipsoidal, maroon, glabrous, about 2½ mm long, separating when ripe and dry into two slender nearly black carpels. Chromosomes 22 (i.e., diploid).

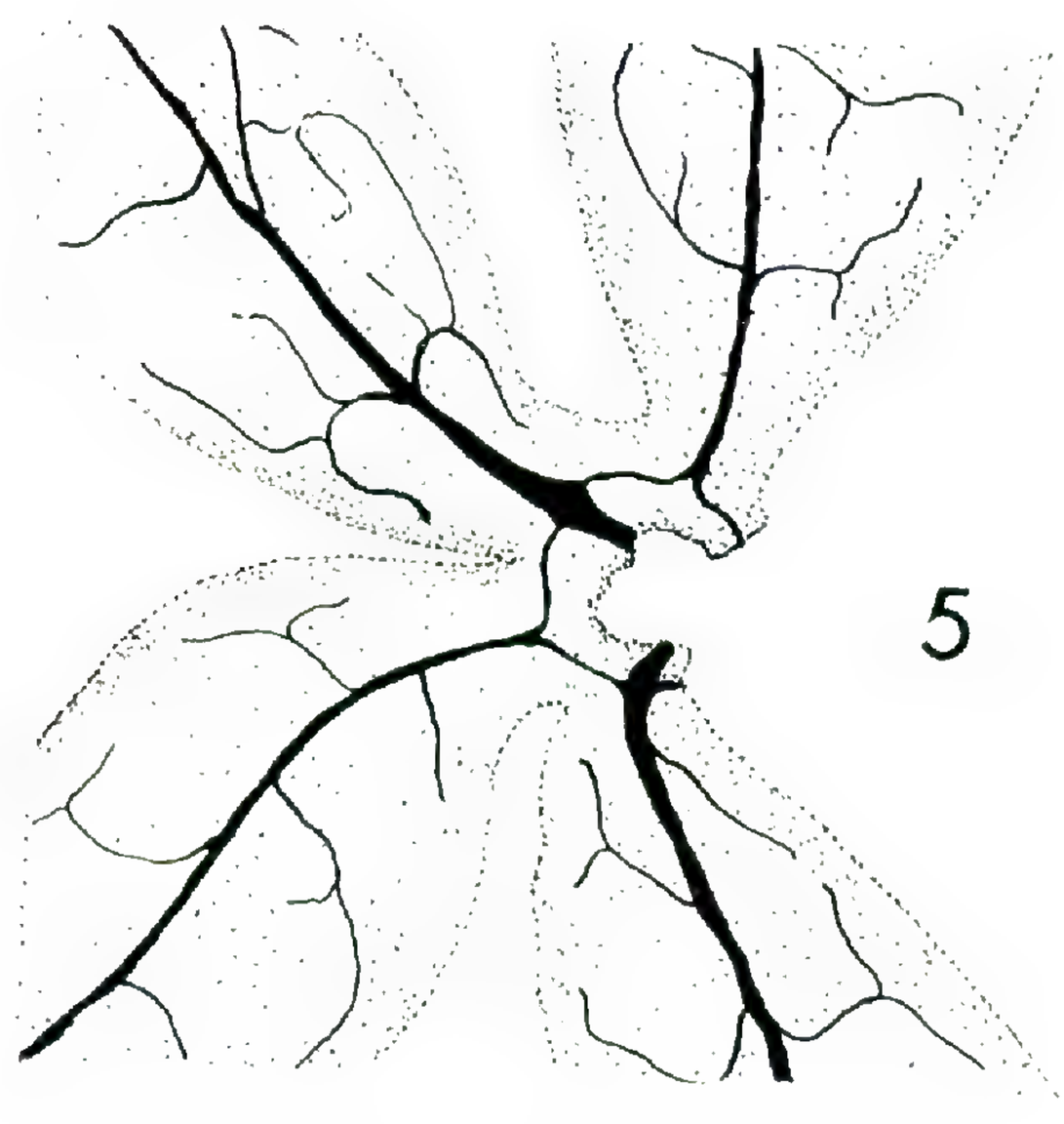
The campanulate corollas of this *Galium* would put it into the genus

SIDA 3 (4): 249—251. 1968.









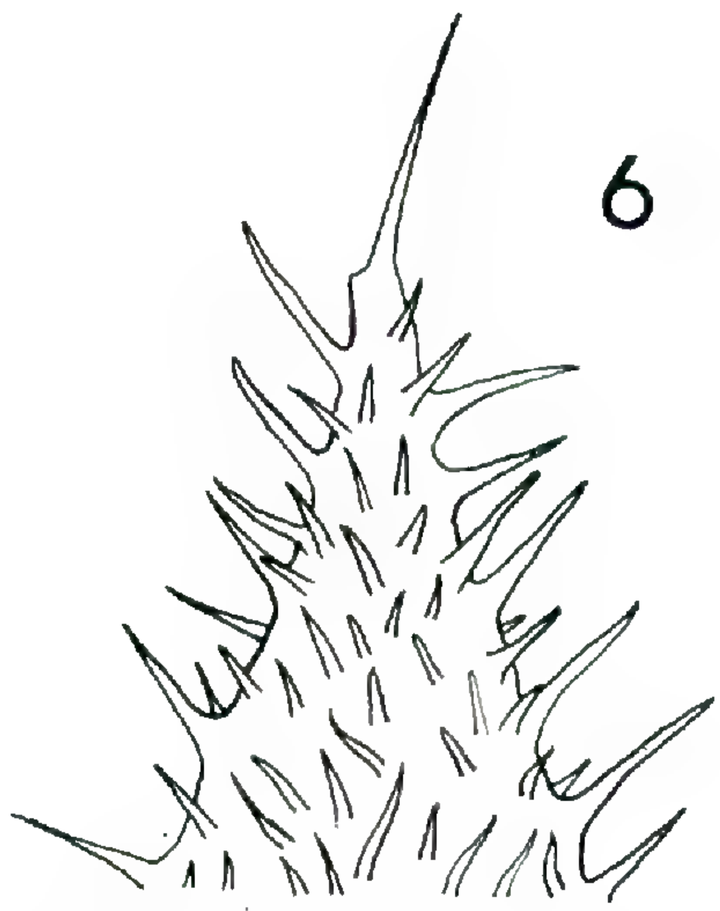


Fig. 1. *Galium correllii* Dempster sp. nov. 1) Node showing 2 leaves and 2 smaller stipular appendages × 14. 2) Somatic prophase × 3400. 3) Fruit × 14. 4) Flower × 14. 5) Cleared leaf bases to show single nerves and connections to basal vascular ring, × 20. 6) Leaf apex × 32.

Asperula, were it from the Old World. However, the corolla tubes are not longer than those of *G. hilendiae* Demp. subsp. *kingstonense* Demp. of the *G. multiflorum* complex. All of *G. hilendiae* and much of *G. multiflorum* sensu stricto have more or less campanulate corollas. For further discussion on this point, the reader is referred to Dempster and Ehrendorfer 1965, pp. 294-295.

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NEW NAMES AND RECORDS IN BRICKELLIA (COMPOSITAE)

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Field and herbarium studies in *Brickellia* have led to the recognition of the following new species and varieties from Texas and adjacent Mexico. Two species are reported for the first time as occurring in Texas.

BRICKELLIA **laccata** Flyr, sp. nov.

B. argutae ut videtur affinis, differt foliis brevioribus vernicosissimis grosse dentatis, involucri squamis numerosioribus angustioribusque, quarum exterioribus apice manifeste attenuatis.

Shrubby cliff-dwelling plants 2.5 dm. or less in height, oppositely and rather intricately branched from near the base. Older branches slender, terete, conspicuously woody, light gray, irregularly striate. Younger branches bright green or brownish, densely glandular with some glands slightly elevated. Leaves opposite, vernicose, with a petiole 1-2 mm. long, the bases cuneate, the blades ovate or somewhat rhomboid, 8-12 mm. long, 4-10 mm. wide, midveins distinct beneath and often with two lateral veins extending one-half the length of the blade, margins coarsely-toothed with 3(-5) broad, blunt to acute teeth on each side, apices acute to slightly acuminate. Heads terminating the short branches, borne on peduncles 0.5-1.5 cm. long, solitary or occasionally sub-cymose (with one or two additional short-peduncled heads arising from the axils of leaves on the same branch), closely subtended by one or two narrow bracts ca. 6 mm. long and 1 mm. or less wide, ca. 47-flowered. Involucres campanulate, 10-15 mm. high, 8-9 mm. wide, of ca. 40 linear to narrowly lanceolate vernicose bracts in several series and of more or less two types: the outer with broad cartilaginous margins and 3 green ribs, rather abruptly contracted at the apex into an attenuate greenish tip 1-5 mm. long, the inner also usually 3-ribbed but purplish on the upper half with scarious margins and apices merely acute or mucronate. Corollas straw-colored below, reddish-brown above, glabrous, very slender, widest at or just below the middle, somewhat contracted near the summit, with blunt nearly linear teeth 0.3 mm. long. Style branches with reddish-brown tips, exserted 1 mm. or less. Achenes dark brown at maturity, cylindrical, 4.3-4.6 mm. long, 10-ribbed, glabrous or hirsutulous (mostly along the ribs). Pappus of ca. 20 white scabrous bristles in one series, 8.0 mm. in length.

MEXICO: northern Coahuila, cliffs of Georgetown limestone, near Aguachile Mountain, 29°18′ N, 102°20′ W., *Flyr 1133*, August 28, 1966. Holotype: SMU; isotypes: TEX, NY, GH. Known only from the type collection.

SIDA 3 (4): 252—256. 1968.

In Robinson's (1917) monograph of the genues, *B. laccata* would be placed in Section *Brickellia* (*Eubrickellia* of Robinson) because of its large heads, and my diagnosis contrasts it to *B. arguta* Rob., one of only two species in that section (the other being *B. atractyloides* Gray) to which it bears even a faint resemblance. It is actually quite closely related to *B. glutinosa* Gray of Section *Bulbostylis*, agreeing in the varnished coating and many details of the habit but differing from the latter by its large heads and in the shape and dentation of the leaves. *B. glutinosa* occurs near the Coahuila-Durango border just south of Torreon and like *B. laccata* apparently exists in small populations in a few localities; the two species have most likely evolved through isolation after break-up of a once continuous area of Cretaceous rocks in northern Mexico.

Brickellia laccata might be expected to occur in Texas, since the type locality is only about twenty miles from the Rio Grande and the plant was found growing with the unusual cliff-dwelling *Cirsium turneri* Warnock, which occurs in a few localities near the Rio Grande in Texas.

BRICKELLIA **viejensis** Flyr, sp. nov.

B. nelsonii affinis, differt caulibus virellis non brunneis, foliis longioribus subcoriaceis conspicue nervis basi subobliquis, petiolis brevioribus, pedunculis crassioribus.

Perennial herb (root not seen) ca. 6 dm. tall. Stems simple, greenish, somewhat furrowed longitudinally, rather densely fine-pubescent; internodes ca. 5 cm. long. Leaves subopposite, with a petiole 4-10 mm. long, the bases somewhat oblique, the blades 6.1-7.5 cm. long, 3.0-4.5 cm. wide, ovate, subcoriaceous and prominently-veined beneath, the midvein and two lateral veins joined near but not at the base, pubescent especially along the veins, inconspicuously glandular-punctate, the margins coarsely serrate, the apices acute; each axil bearing a small lanceolate or lanceoblong secondary leaf. Inflorescence a few-headed open panicle, the heads ca. 14 mm. high, 6-7 mm. wide, borne on rather thick densely hispid peduncles. Involucre of ca. 18 linear bracts with acute apices, the outer pilose near the margin; florets ca. 14. Corollas 6 mm. long, with a slender tube and narrow but distinct limb. Achenes 4 mm. long, 10-ribbed, with appressed tawny pubescence. Pappus of ca. 30 subequal scabrous bristles, 7-8 mm. long.

TEXAS: Presidio Co., Knox Canyon, Tierra Vieja Mts., *L. C. Hinckley 2024*, July 20, 1941. Holotype: US. Known only from this collection.

This new species, quite unlike any other *Brickellia* from Texas or northwestern Mexico, is related to *B. nelsonii* Rob. of Nuevo Leon and Tamaulipas. It differs from the latter, in addition to the characters mentioned in the diagnosis, by its slightly larger heads, generally coarse aspect, and by the divergence of the three main leaf veins above (instead of at) the base of the blade. Though known from a single collection, I am giving it formal recognition because of these several differ-

ences. The Sierra Tierra Vieja is still not well-collected, and across the Rio Grande in Chihuahua is an area of considerable size even less well known.

BRICKELLIA **shineri** M. E. Jones ex Flyr, sp. nov.

Species achaeniis 5-angulatis sicut in genere Eupatorio, sed Brickelliae speciebus multis convenit phyllariis viridescentibus longitudine striatis pluriseriatis, corollae angustae dentibus inconspicuis erectis. A Brickelliae speciebus aliis distinguenda petiolis anguste alatis, pubescentia glanduloso-stipitata et phyllariis subulatis.

Holotype (POM): *M. E. Jones 29411*, March 25, 1932, Ojo de Agua, about 2½ miles from Sabinas Hidalgo, Nuevo Leon, MEXICO. (Correct locality and date from Blake, Contr. U. S. Nat. Herb. 29(2):117-137. 1945.)

Brickellia shineri M. E. Jones, Contr. West. Bot. 18:22. 1935, without Latin diagnosis.

Eupatorium parryi Gray, in Torr. Bot. Mex. Bound. 75. 1859. Not *Brickellia parryi* Gray, Proc. Am. Acad. 15:31. 1879.

The diagnostic characters of petiole, pubescence and involucral bracts are not to be taken individually but in combination for separating *B. shineri* from its congeners. The 5-angled achenes will distinguish the species from all but *B. fendleri*, in which 5-10 ribs may be found on the 5-angled fruit. The merely obtuse or acute involucral bracts of *B. fendleri*, however, as well as its broad involucre set it apart from *B. shineri*, in which the bracts are contracted at the apex to needle-like points and the involucre is about twice as high as wide.

Treatment of this taxon as a species of *Brickellia* at once erases the traditional character—number of angles and ribs on the achene—used in separating two genera with a total of several hundred species, although uncertainty as to the proper placement of *B. fendleri* by Gray was evidence that a single character could not be employed in separating *Brickellia* and *Eupatorium*. I do not favor merging the genera but expect that a combination of morphological features, as adumbrated in the diagnosis above, will distinguish the two genera without isolating any species from its closest relatives, as I believe has been done in the past with *B. shineri*.

BRICKELLIA BRACHYPHYLLA (Gray) Gray var. **terlinguensis** Flyr, var. nov.

Varietas ab brachyphylla differt capitulis grandioribus, caulibus dense glandiferis, foliis angustioribus crassioribusque.

This variety has been collected from the slopes of the Chisos Mountains northwest to the Eagle Mountains in Hudspeth County. The varietal epithet is taken from the much-publicized Brewster County ghost town of Terlingua, where the plant has been collected (*Warnock 20991*, August 31, 1937: TEX, LL). I take as type a collection of Mary S. Young

from the Chisos Mountains, Brewster County, August 7, 1915 (Holotype: TEX; isotype probably at MO).

BRICKELLIA BRACHYPHYLLA var. **hinckleyi** (Standl.) Flyr, comb. nov.

Brickellia hinckleyi Standl. Field Mus. Publ. Bot. 22(1):61. 1940.

This plant has been collected only in a small area on the north slope of Mount Livermore in the Davis Mountains. In addition to the type, I have seen the following collection: *Warnock 7385,* September 11, 1947 (TEX, LL). The large heads and stipitate glandular pubescence set it apart from var. *brachyphylla.* The heads are also larger than in the preceding variety, which differs further in its smaller, narrower and more coriaceous leaves as well as being more densely glandular than var. *hinckleyi.*

Standley apparently overlooked the obvious similarities of this taxon to *B. brachyphylla,* although the relationship cuts across sectional lines established by Robinson (1917).

BRICKELLIA VENOSA (Woot. & Standl.) Rob.

Not previously reported from Texas. It has been collected only in El Paso County: "east lower slope along the arroyos of the Franklin Mountains; about eight miles from El Paso toward the White Sands. Altitude 4600 feet", *Warnock 14231,* September 29, 1956 (LL). Otherwise, the species occurs in New Mexico and Arizona as well as the Mexican states of Sonora and Chihuahua. A closely related species, *B. oliganthes* (Less.) Gray, has been reported by Sperry (1938) as occurring in the Chisos Mountains, Brewster County, but all specimens I have seen so-labeled are either *B, cylindracea* Gray & Engelm. or *B. conduplicata* (Rob.)Rob.

BRICKELLIA CONDUPLICATA (Rob.)Rob.

This species has not been included in any of the checklists of Texas plants even though Robinson (1917) discussed a plant, collected by Havard in the Sierra Tierra Vieja of Presidio County, which he provisionally referred to *B. conduplicata.* The short-petioled leaves on this specimen could have placed it in *B. cylindracea* Gray & Engelm. I have seen the Havard collection (GH, US) and like Robinson cannot identify it positively. Considering the wide variation of leaf form in *B. cylindracea, B. conduplicata* may have to be treated as a synonym of the other species, although plants from southern Brewster and Presidio counties seem to have longer petioles, more broadly ovate leaves and less dense inflorescences than in other parts of the range of *B. cylindracea.* The obvious difference of conduplicate versus flat leaf blade is mostly an artifact of pressing. Both configurations occur in the same population: those appearing conduplicate in dried specimens are actually blades whcse halves make an angle of about 150° in the living plant.

I am grateful to Dr. Lloyd H. Shinners for suggesting changes in the

manuscript and for providing the Latin diagnosis for *Brickellia shineri*. My appreciation is also extended to the curators of the following herbaria for the loan of specimens: LL, GH, SMU, US. Support during this study at the Department of Botany, University of Texas, Austin, came from a National Science Foundation summer traineeship in systematic biology. Field work was done with the aid of a NSF grant to Dr. Lloyd H. Shinners of Southern Methodist University. Dr. Michael Powell, Dr. John Strother, and Mr. Dan Gorski were of much assistance in the field work.

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STUDIES IN THE COMPOSITAE-EUPATORIEAE VIII. OBSERVATIONS ON THE MICROSTRUCTURE OF STEVIA.

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During the past two years we have examined many genera and species of the tribe Eupatorieae microscopically in an effort to clarify generic concepts. The methods fcllowed are essentially those outlined in the revision of the *Hofmeisteria* complex (King & H. Robinson, 1966). By applying these methods to the genus *Stevia*, distinctive microscopic characters have been recognized and a distinct genus, *Cronquistia* (King 1967) has been segregated. During this process a number of microscopic characters of possible specific or even subgeneric value have been observed. Among these characters are variations in pollen form (King & H. Robinson 1968), corolla pubescence, and pubescence on the achene. A brief summary of these characters is offered here with some suggestions as to their possible taxonomic significance.

Most of the observations were made from material in the U.S. National Herbarium. The loan of a large number of types of *Stevia* from the Gray Herbarium is gratefully acknowledged. Attempts have been made to correct for synonymy or misdeterminations where these are known; however, since a complete monographic review has not been undertaken, some of the cited material may be misnamed.

I Pubescence of the achene.

Essentially all species of *Stevia* examined have distinct setae borne on the ribs of the achenes, a character similar to most other genera of the tribe. In some specimens of *Stevia* these setae are very short and may be essentially lacking. One Mexican species, *S. monardaefolia* H.B.K., the achenes are usually nearly to completely without pubescence.

In certain species, mostly South American, the setae of the achenes are intermixed with glands. Such glands have been seen on the following species from southern Brazil and adjacent areas.

S. ammotropha B.L. Robins. (*Hassler 9347*, GH, type).
S. aristata D. Don *ex* Hook & Arn. (*Gillies 162*, GH, isotype).
S. balansae Hieron. (*Hassler 5955*, GH, type of *S. hassleriana* Chod.)
S. burkartii B.L. Robins. (*Burkart 1149*, GH, type).
S. entreriensis Hieron (*Lorentz 952*, US, type).
S. guaranitica Chod. (*Hassler 6617*).
S. ophryophylla B.L. Robins. (*Brade 7084*, GH, type).
S. rebaudiana Bertoni (*Jack 5353*, US).

S. sarensis B.L. Robins. (*Steinbach 7048*, GH, type).
S. sarensis B.L. Robins. var. *dissiticeps* B.L. Robins. (*Steinbach 6248*, GH, isotype).
S. villaricensis (B.L. Robins.) Cabrera & Vittet (*Jörgensen 4267* in part, GH, type).

In structure these glands are like those of the corolla. If the few specimens examined are indicative, there is some variation between species in the relative numbers of setae versus glands. In *S. burkartii* there seem to be no setae. In *S. aristata, S. ophryophylla,* and *S. rebaudiana* a few distinct setae are present. In *S. ammotropha* the setae are concentrated at the lower end of the achene with mostly glands upward. In *S. guaranitica, S. hassleriana,* and *S. sarensis* glands are relatively sparse and intermixed among the setae.

Many of the species with glands on the achenes have ten or more pappus setae. Of the multiaristate group B.L. Robinson (1930) made the following remark:

". . . in the multiaristate series represented by Types VIII and IX there are a very few (chiefly Brazilian) species in which the awns usually range from seven to twelve, but sometimes drop to four, five or six. Thus the separation between the pauciaristate and multiaristate series would seem to break down. However, it is clearly a natural distinction of some importance."

It would seem that this Austral element in the genus *Stevia* is a distinctive series in which both multiaristate pappus structure and glandular achenes are found. The two characters are not completely correlated in their occurrence and no single unifying character for all the species having either character is presently known.

In one Mexican species, *S. vernicosa* Greenman (*Pringle 7698,* type GH), glands are present on the achene. In other characters this species is related to *S. salicifolia,* in a species group lacking glandular achenes. Occasionally glands have been observed on the achenes of other species such as *S. lucida (Purpus 3036,* US, type of var. *pueblensis* B.L. Robins., a specimen in which achene-type setae also occur in the corolla tube) and *S. dictyophylla* B.L. Robins. *(Pringle 2832,* GH), but as yet no gland bearing achenes have been observed in species showing the modified pollens discussed below.

II Pollen variation.

An element in the genus apparently representing the opposite pole from the multiaristate and glandular achened species is that showing pollen variations. The extreme variations in two Mexican species, *S. pilosa* Lag. and *S. purpurea* Pers., have already been reviewed (King & H. Robinson, 1967). The taxonomic usefulness of pollen types is limited by the variation in individual species, and only careful evaluation of many specimens of each will reveal in which species the variations oc-

cur. Nevertheless, the available sample indicates the variations are centered in Mexico. A few widely distributed species ranging from Mexico as far south as Peru have modified pollen. Pollen variations have not been found in any of the multiaristate or glandular achened species. This suggests that the variations are restricted to a second large subgroup within the genus *Stevia*. No other character distinguishing the subgroup is presently known.

The types of pollen observed in *Stevia* are as follows:

Aborted—In flowers that are otherwise completely mature, anthers are underdeveloped and distinct pollen grains are absent.

Type I—Pollen grains spherical, averaging 25μ in diameter, tricolpate, usually radially symmetric.

Type II—Pollen grains spherical, averaging 30-40μ in diameter, the intersecting furrows usually very asymmetrically arranged.

Type III—Pollen grains elongated, short cylindrical or dumbbell shaped, lesser axes 30-35μ in diameter, surface features similar to those of Type II but complicated by the elongate or double nature of the grain.

The pollen types are uniform throughout any one specimen, but type I & II, and types II & III have been seen mixed together in anthers of some specimens.

Anthers with pollen apparently aborted have been observed in only *S. pilosa* and *S. purpurea* where a full range of pollen variation is known to occur (King & H. Robinson, 1967).

Pollen type I seems to be the basic pollen type of the genus, and has been observed in all of the species restricted to South America, and in at least some specimens of most Mexican and Central American species. The presence of this pollen type seems to have no taxonomic significance and grains seem to be of the same form in all species.

Pollen type II has been observed in the following species:

S. alatipes B.L. Robins. (*Pringle 10124*, US, type).

S. clinopodioides Greenm. (*Pringle 6594*, US, isotype).

S. connata Lag. (*Bourgeau 3243*, US).

S. cordifolia Benth. (*Hartweg 304*, GH, type frag.).

S. deltoidea Greene (*Pringle 4976*, GH, isotype).

S. elliptica Hook. & Arn. (*Sinclair s.n.*, US, type frag.).

S. elongata H.B.K. (*King & Soderstrom 5111*, US; *Jahn 1098*, US as var. *caracasana* (DC) B.L. Robins.).

S. jorullensis H.B.K. (*Pringle 4973*, US).

S. lehmannii Hieron. (*Lehman 5199*, US, type).

S. liebmannii Sch. Bip. ex Klatt (*Liebmann 125*, US, type frag.; *Purpus 9100*, US, isotype of var. *chiapensis* B.L. Robins.; *Pringle 4974*, US, type of *S. decumbens* Greene).

S. micradenia B.L. Robins. (*Pringle 5051*, US, isotype as *S. laxa* B.L. Robins. & Seaton).

S. monardaefolia H.B.K. (*Pringle 743*, GH, type of *S. amblyolepis* var. *umbratilis* B.L. Robins.).
S. nepetaefolia H.B.K. (*Purpus 1484*, US).
S. orizabensis B.L. Robins. (*Bourgeau 3331*, GH, type).
S. paniculata Lag. (*Carter & Chisaki 3475*, US).
S. pilosa Lag. (*Berlandier 663, 793, 808*, on one sheet, US, type of *S. conferta* var *puberula* DC., & see King and H. Robinson, 1967).
S. plummerae A. Gray (*Lemmon 2730*, US, type; *Pennell 19216*, US; *Lemmon 2731*, US, type of var. *alba* A. Gray; *Pringle 10106*, US, type of var. *durangensis* B.L. Robins.).
S. purpurea Pers. (see King and H. Robinson, 1967).
S. purpusii B.L. Robins. (*Pringle 11294*, US, isotype).
S. reglensis Benth. (*Hartweg 308*, GH, type frag.).
S. rhombifolia H.B.K. (*Cronquist 9555*, US; *Palmer 958* in 1896, US, type of f. *colorata* B.L. Robins.
S. satureiaefolia Sch. Bip. var. *hirsuta* (Hook. & Arn.) Baker (*Cronquist 9720*, US).
S. seemannii Sch. Bip. (*Seeman 2041*, GH, type; *Seler 1602*, GH, type of var. *selerorum* B.L. Robins.).
S. serrata Cav. (*Palmer 750* in 1896, US, isotype of var. *haplopappa* B.L. Robins.; *Pringle 7652*, GH, type of var. *arguta* B.L. Robins.; *Pringle 8229*, US, type of *S. tephra* B.L. Robins.).
S. tomentosa H.B.K. (*Seaton 487*, GH, type of var. *seatonii* B.L. Robins.).
S. viscida H.B.K. (*Pringle 10092*, US, isotype of *S. lozanoi* B.L. Robins.; *Palmer 791*, US).

All of these species occur in Mexico with *S. plummerae* ranging northward into the United States and *S. serrata* and *S. elongata* ranging southward into South America. In addition to *S. pilosa* and *S. purpurea*, there are other specimens of three of these species, *S. elatior* var *podophylla* B.L. Robins. (*Purpus 3132*, type US), *S. monardaefolia* (*Goldman 116*, type of *S. amblyolepis* B.L. Robins., GH), and *S. rhombifolia* (*Pennell 18504*, var. *stephanocoma* f. *glandulifera* B.L. Robins., US; *H.S. Gentry 7304*, var. *stephanocoma* Sch.-Bip., US; *Palmer 958* in 1896, var *typica* f. *colorata* B.L. Robins., type US) in which additional pollen type (type I) occurs. In another species, *S. serrata*, in the three specimens cited, pollen types I and II are intermixed in the anthers.

It is very difficult to reconstruct the actual pattern of the furrows in the pollen type II grains because of variation from one grain to another and the lack of symmetry. However, a number of species have been carefully reviewed and *S. alatipes* (Figs. 2-5), *S. connata* (Fig. 6), *S. elongata* (Figs. 7-9), *S. monardaefolia* (Figs. 10-11), *S. pilosa*, *S. purpurea*, *S. purpusii* (Figs. 14-16), *S. rhombifolia* (Figs. 17-18), *S. satureiaefolia* Figs. 19-22), and *S. viscida* (Fig. 23) all have pollen type II that is essentially the same. In these (type IIa) the surface is dissected by the furrows into four spinose plates. In some grains more plates may be

present but these have not been observed with certainty. The commonest form of grain has one rectangular plate extending ¾ of the way around the grain, and at one corner this largest plate is usually narrowly attached to two adjacent smaller plates. Modifications include grains with two rectangular plates extending halfway around the grain. A number of more irregular arrangements have been observed (Figs. 16, 18). In *S. viscida,* the grains seemed to have unusually wide furrows.

In another group of species with pollen type II the structure seems basically different. These include *S. plummerae* (Figs 25-29), *S. seemannii* (Figs. 30-32), and *S. tomentosa* var. *seatonii* (Figs. 36-38). None of these show the forms of pollen that are most common in the previously listed species. In all of these the pollen grains (type IIb) seem to have the surface usually divided into five plates, and none of the plates extend more than halfway around the grain.

In one species, *S. micradenia,* a very distinctive pollen form is present. Many grains (type IIc) show seven plates, one at each end and five arranged symmetrically around the sides (Figs. 39-45). Such grains have not been observed in any other species. In the specimen examined these grains are intermixed with others showing four or five plates asymmetrically arranged.

After exhaustive examinations it may be possible to determine patterns of relationship in the pollen type II. The difficulty in determining exact structure and the variability within species will limit the use of pollen in identification of species.

Pollen type III has been seen in only *S. pilosa* and *S. purpurea.* It is known from four specimens of *S. pilosa* and one specimen of *S. purpurea* (King & H. Robinson, 1967). On the basis of these specimens each species seems to have a distinctive form of pollen type III. The type II grains of these species are essentially alike, and the differences in type III may be only the result of relative orientation of basic type II features on the elongate (double?) grain. In *S. pilosa* the furrows are transverse and circle the grain (Figs. 12-13). In *S. purpurea* the furrows tend to be longitudinal. Certainly, type III pollens hold the greatest potential for specific distinctions and further records of this pollen type should be sought in *S. pilosa, S. purpurea,* and other species.

III Corolla pubescence.

It would seem that the well known variability of pubescence on leaves, stems, and bracts of Compositae has prejudiced taxonomists against the character completely. It is, in fact, rather surprising to discover that pubescence on the corolla in many Eupatorieae is apparently a generic character as shown in the study of the *Hofmeisteria* complex (King and H. Robinson, 1966). Though such pubescence has been observed previously with low magnification, critical features can be observed only by use of the compound microscope. In *Stevia,* as in the *Hofmeisteria* complex, the genus shows certain distinctive pubescence characters including

the presence of both glands or glandular hairs on the outer surface and long glandless hairs on the inner surface in all species, and the presence of usually shorter and thicker-walled hairs on the outer surface in most species.

On the basis of a present small sampling of specimens many species seem to be distinctive in form and actual arrangement of the hairs on the outer surface of the corolla. The most distinctive group is that completely lacking hairs on all or at least the upper part of the outer surface. The following species completely lack hairs:

S. glutinosa H.B.K. (*Morley 653*, US).
S. pyrolaefolia Schlecht. (*H.E. Moore 1738*, US).
S. salicifolia Cav. (*Cronquist 9531*, US; *Rose, Painter, Rose 8275*, US).
S. salicifolia Cav. var. *anathera* B.L. Robins. (*Palmer 401*, US, isotype).
S. salicifolia Cav. var. *integra* (Blake) B.L. Robins. (*Purpus 4722*, US, type).
S. salicifolia Cav. var. *nana* A. Gray (*Parry & Palmer 326* in 1878, US, type).
S. salicifolia Cav. var. *virgulifera* B.L. Robins (*Palmer 29* in 1896, US, isotype).
S. venosa A. Gray (*Palmer 376* in 1885, US, type).
S. vernicosa Greenm. (*Pringle 7698*, GH, type).

The following species have hairs only on the base of the corolla:

S. lucida Lag. (*McVaugh 10031*, US).
S. lucida Lag. var. *bipontini* B.L. Robins. (*Liebmann 128*, US, Isotype frag. of *S. grandidentata* Sch. Bip.).
S. lucida Lag. var. *opaca* B.L. Robins (*Seamann 2028*, GH, type).
S. lucida Lag. var. *pueblensis* B.L. Robins. (*Purpus 3036*, US, type).
S. nelsonii B.L. Robins. (*Nelson 6579*, US, type).
S. salicifolia Cav. var. *collodes* (Greenm.) B.L. Robins. (*Pringle 8570*, US, isotype).

The species of these two groups show a number of characters of interest and are considered in more detail in the following section.

The following species have hairs only on the upper part of the corolla:

S. ammotropha B.L. Robins. (*Hassler 9347*, GH, type).
S. berlandieri A. Gray (*Berlandier* 3160, US, type).
S. bridgesii Rusby (*Bang 3047*, US, type).
S. dictyophylla B.L. Robins. (*Hartweg 137*, GH, type as *S. subpubescens* Benth.).
S. guaranitica Chod. (*Hassler 6617*, US).
S. hypericifolia Hieron. (*Regnell III 677*, GH, isotype).
S. lehmannii Hieron. (*Lehmann 5199*, US, isotype).
S. monardaefolia H.B.K. (*Goldman 116*, GH, type of *S. amblyolepis* B.L. Robins.).
S. monardaefolia H.B.K. var. *macrophylla* B.L. Robins. (*Pringle 8057*, US, isotype).

S. monardaefolia H.B.K. var. *repens* B. L. Robins. (*Mexia 1610,* US, type).
S. neurophylla B.L. Robins. & Greenm. (*Nelson 2133,* US, type).
S. polycephala Bertol. (*J.D. Smith 2327,* US, type of *S. arachnoidea* B.L. Robins.).
S. plummerae A. Gray (*Lemmon 2730,* US, type; *Palmer 328* in 1885, US, type of *S. madrensis* A. Gray).
S. plummerae A. Gray var. *alba* A. Gray (*Lemmon 2730,* US, type).
S. plummerae A. Gray var. *durangensis* B.L. Robins. (*Pringle 10106,* US, type).
S. reglensis Benth. (*Hartweg 308,* GH, type frag.; *Pringle 6530,* US).
S. scabrella Benth. (*Hartweg 141,* GH, type).
S. seleriana B.L. Robins. (*Seler 1695,* GH, type).
S. seemannii Sch. Bip. (*Seamann 2041,* GH, type).
S. selloi var. *ypacarayensis* B.L. Robins. (*Hassler 12154,* US, type).

In *S. bridgesii* and *S. reglensis* the hairs are very small and sometimes difficult to see. In this group the corolla is usually covered with glands below but *S. neurophylla* has glands very sparse on the corolla nearly bare below.

In the following species the hairs are mostly on the upper part of the corolla, scattered in the middle and very sparse below:

S. alatipes B.L. Robins. (*Pringle 10124,* US, type).
S. balansae Hieron. (*Hassler 5955,* GH, type of *S. hassleriana* Chod.).
S. berlandieri A. Gray var *anadenotricha* B.L. Robins. (*Palmer 257* in 1885, US, isotype).
S. clivicola B.L. Robins. (*Mandon 143* in part, GH, type).
S. dictyophylla B.L. Robins. (*Pringle 2832,* GH).
S. dissitifolia DC. (*Martínez 129,* US).
S. elliptica Hook. & Arn. (*Sinclair s.n.,* US, type frag.).
S. elongata H.B.K. (*King & Soderstrom 3111,* US).
S. elongata H.B.K. var. *caracasana* (DC.) B.L. Robins. (*Langlassé 775,* US).
S. eupatoria Willd. (*H.E. Moore 3506,* US).
S. filipes Rusby (*R. S. Williams 124,* US, type).
S. flourensioides Blake (*Purpus 1470,* US, type).
S. liebmannii Sch. Bip. ex Klatt (*Liebmann 125,* US, type frag.).
S. micradenia B.L. Robins. (*Pringle 5051,* US, isotype as *S. laxa* B.L. Robins. & Seaton).
S. microchaeta Sch. Bip. (*Liebmann 120,* US, isotype?).
S. monardaefolia H.B.K. (*Pringle 743,* GH, type of *S. amblyolepis* var. *umbratilis* B.L. Robins.).
S. pelophila Blake (*García 387,* US, type; *Maysilles 7594,* US).
S. phlebophylla A. Gray (*Palmer 676* in 1886, US, type).
S. pilosa Lag. (see King & Robinson, 1967; *Berlandier 663, 793, 808,* US, type of var. *puberula* (DC.) B.L. Robins.).

S. polycephala Bertol. (*Skutch 170*, US).
S. purpurea Pers. (see King & Robinson, 1967).
S. revoluta B.L. Robins. (*Purpus 2539*, US, type).
S. tephrophylla Blake (*Goldman 1049*, US, type).
S. viscida H.B.K. (*Pringle 10092*, US, isotype of *S. lozanoi* B.L. Robins.; *Lemmon 2729*, US, type of *S. amabilis* Lemmon; *Palmer 791*, US).

This group intergrades considerably with the next, and some species seem to vary, but the apparently related *S. pilosa*, *S. purpurea*, and *S. viscida* seem to consistently show this type.

The following species have hairs prominently above and below but sparse or lacking between:

S. andina B.L. Robins. (*A.S. Hitchcok 21475*, US, type).
S. aschenborniana Sch. Bip. (*Cronquist 9734*, US; *Pringle 6608*, US, isotype of *S. diffusa* Greenm.).
S. bangii Rusby (*Bang 86*, US, isotype).
S. bangii var. *dyscrita* B.L. Robins. (*Buchtien 186*, GH, type).
S. benderi Perkins var. *cardenasii* B.L. Robins. (*Cardenas 480*, GH, type).
S. burkartii B.L. Robins. (*Burkart 1149*, GH, type).
S. camachensis Hieron. (*Fiebrig 2868a*, US, type).
S. chacoensis R.E. Fries (*Fries 1388*, US, isotype).
S. chamaedrys Griseb. (*Lorentz & Hieronymus 171*, US, isotype).
S. connata Lag. (*Bourgeau 3243*, US).
S. cordifolia Benth. (*Hartweg 304*, GH, type frag.).
S. deltoidea Greene (*Pringle 4976*, GH, isotype).
S. discolor B.L. Robins. (*Mandon 242* in part, GH, type).
S. eclipes B.L. Robins. (*Fiebrig 3126*, US, type).
S. elatior H.B.K. var. *podophylla* B.L. Robins. (*Purpus 3132*, US, type).
S. entreriensis Hieron. (*Lorentz 952*, US, type frag.).
S. fiebrigii Hieron. var. *gracillima* B.L. Robins. (*Venturi 3679*, US, type).
S. gilliesii Hook. & Arn. (*T.Stuckert 17106*, GH, isotype).
S. glandulosa Hook & Arn. (*Sinclair s.n.*, US, isotype).
S. jorullensis H.B.K. (*Pringle 4973*, US).
S. karwinskyana Steud. (*Purpus 2856*, US).
S. leucosticta B.L. Robins (*Macbride & Featherstone 1382*, GH, type).
S. liebmannii Sch. Bip. ex Klatt var. *chiapensis* B.L. Robins. (*Purpus 9100*, US, isotype).
S. macbridei B.L. Robins. (*Macbride & Featherstone 1613*, GH, type).
S. macbridei var. *anomala* B.L. Robins. (*C.L. Gay 379*, GH, type).
S. mandonii Sch. Bip. (*Mandon 246*, GH, type).
S. menthaefolia Sch. Bip. (*Claussen s.n.*, US, isotype).
S. microchaeta Sch. Bip. (*Botteri 487*, US).
S. mitopoda B.L. Robins. (*Seler & Seler 4286*, GH, type).
S. neglecta Rusby (*Bang 611*, US, isotype).
S. nepetaefolia H.B.K. (*Purpus 1484*, US).
S. obovata Rusby (*Bang 1027*, US, type).

S. obovata var. *aristifera* B.L. Robins. (*Steinbach 8831*, GH, type).
S. ophryophylla B.L. Robins. (*Brade 7084*, GH, type).
S. origanoides H.B.K. (*Pringle 8703*, US).
S. organensis Gardn. (*Gardner 512*, US, type frag.).
S. orizabensis B.L. Robins. (*Bourgeau 3331*, GH, type).
S. paniculata Lag. (*Carter & Chisaki 3475*, US).
S. pennellii B.L. Robins. (*Pennell 13883*, GH, type).
S. plummerae A. Gray (*Rusby 157½*, US; *Harrison 3054*, US; *Pereyra 5823*, GH, type of *S. mercedensis* Hieron. var. *pereyrae* B.L. Robins.).
S. purdiei B.L. Robins. (*Purdie s.n.*, GH, type).
S. purpusii B.L. Robins. (*Pringle 11294*, US, isotype).
S. rebaudiana Bertoni (*Jack 5353*, US).
S. reclinata Rusby (*R.S. Williams 1468*, US, type).
S. rhombifolia H.B.K. (*Cronquist 9555*, US; *Ferrera 7198*, US).
S. rhombifolia f. *colorata* B.L. Robins. (*Palmer 958* in 1896, US, type).
S. rhombifolia var. *stephanocoma* Sch. Bip. (*Gentry 7304*, US).
S. rhombifolia var. *stephanocoma* f. *glandulifera* B.L. Robins. (*Pennell 18504*, US).
S. riedelii Sch. Bip. (*Riedel s.n.*, GH, type).
S. rosei B.L. Robins. (*Rose 2994*, US, type).
S. sarensis B.L. Robins. (*Steinbach 7048*, GH, type).
S. sarensis var. *dissiticeps* B.L. Robins. (*Steinbach 6248*, GH, isotype).
S. satureiaefolia Sch. Bip. var. *hirsuta* (Hook & Arn.) Baker (*Cronquist 9720*, US).
S. scabridula B.L. Robins. (*Palmer 592* in 1886, US, isotype).
S. seemannii Sch. Bip. var. *selerorum* B.L. Robins. (*Seler 1602*, GH, type).
S. serrata Cav. var. *arguta* B.L. Robins. (*Pringle 7652*, GH, type).
S. serrata var. *haplopappa* B.L. Robins (*Palmer 750 in 1896*, US, isotype).
S. serrata var. *ivaefolia* B.L. Robins. (*Pringle 8229*, US, type of *S. tephra* B.L. Robins.).
S. tomentosa H.B.K. var. *seatonii* B.L. Robins. (*H.E. Seaton 487*, GH, type).
S. trachelioides DC. (*Berlandier 1164*, US, isotype).
S. urticaefolia Thunb. var. *pallidiflora* B.L. Robins. (*Bang 2877*, US, type).
S. villaricensis (B.L. Robins.) Cabrera & Vittet (*Jorgensen 4267* in part, GH, type).
S. weberbaueri B.L. Robins. (*Weberbauer 7293*, US, type).
S. yaconensis Hieron. var. *subeglandulosa* Hieron. (*Fiebrig 2330*, GH, type).

In a final group the entire outer surface of the corolla tends to be very hairy:

S. hypomalaca B.L. Robins. (*Pringle 6603*, US, isotype).

S. jaliscensis B.L. Robins. (*Pringle 1773*, US, isotype).
S. lemmonii A. Gray (*Lemmon 149 in 1881*, GH, type).
S. liebmannii Sch. Bip. ex Klatt (*Pringle 4974*, US, type of *S. decumbens* Greene).
S. lilloi B.L. Robins. (*Lillo 15926*, GH, type).
S. micrantha Lag. (*Pennell 19275*, US; *Wright 1130*, US, isotype of *S. macella* A. Gray).
S. palmeri A. Gray (*Palmer 30* in 1885, US, type).
S. schreiteri B.L. Robins. (*Schreiter* 3637, GH, type).
S. serrata Cav. (*Blumer 1478*, US).
S. serrata Cav. var. *haplopappa* B.L. Robins. (*Palmer 750* in 1896, US, isotype).
S. serrata Cav. var. *ovalis* B.L. Robins. (*Palmer 309* in 1886, US, type).

In one of these, *S. schreiteri*, hairs occur almost to the exclusion of glands which are few and restricted to the lobes of the corolla.

In a few cases the same species may occur in different lists. In some cases this may be the result from real variation in the species. In others it may represent species concepts that need reevaluation. For example in *S. serrata* most material is densely hairy throughout, but some varieties appear to have sparse pubescence in the middle. In some material of *S. plummerae* hairs are restricted to the upper part, but often there are some hairs on the lower part. In contrast to these variations the *S. pilosa* and *S. salicifolia* groups have related species showing similar types of pubescence. When the limits of variation of the other species are determined other such related groups may become evident.

IV Base of the style.

In one group of specimens, all of which lack external hairs on the upper part of the corolla, the base of the style has projecting cells forming papillae or in the extreme even short filaments. These have been seen in the following material:
S. glutinosa H.B.K. (*Morley 653*, US).
S. pyrolaefolia Schlecht. (*H.E. Moore 1738*, US).
S. salicifolia Cav. (*Cronquist 9531*, US; *Rose, Painter, Rose 8275*, US).
S. salicifolia Cav. var. *anathera* B.L. Robins. (*Palmer 401*, US, isotype).
S. salicifolia Cav. var. *collodes* (Greenm.) B.L. Robins. (*Pringle 8570*, US, isotype).
S. salicifolia Cav. var. *integra* (Blake) B.L. Robins. (*Purpus 4722*, US, type).
S. salicifolia Cav. var. *nana* A. Gray (*Parry & Palmer 326* in 1878, US, type).
S. salicifolia Cav. var. *virgulifera* B.L. Robins. (*Palmer 29* in 1896, US, isotype).
S. venosa A. Gray (*Palmer 376* in 1885, US, type).
S. vernicosa Greenm. (*Pringle 7698*, GH, type).
This character seems to reflect unquestionably a related group and has

not been seen in any other species of the genus. This is not necessarily a key character for the group as one specimen of *S. salicifolia* showing other characters of the species, lacks the papillae on the style. Still, the papillae are present on all other material of *S. salicifolia* and its close relatives that have been seen and distinguishes them from specimens of *S. lucida,* the other common species lacking hairs on the backs of corolla lobes.

Within the *S. salicifolia* group there are two species, *S. vernicosa* and *S. salicifolia* var. *collodes* showing distinct flower features. In *S. vernicosa* the achene bears some glands, a character so far found only occasionally in *S. lucida* and *S. dictyophylla* and otherwise restricted to South American species. This may indicate a closer relationship of this group to the multiaristate species of South America than to the species with modified pollen in Central America. In *S. salicifolia* var. *collodes* the corolla bears many hairs on the lower part as does *S. lucida.* The relationship of the variety *collodes* otherwise seems to be clearly with *S. salicifolia* which very rarely has one or two external hairs on the corolla.

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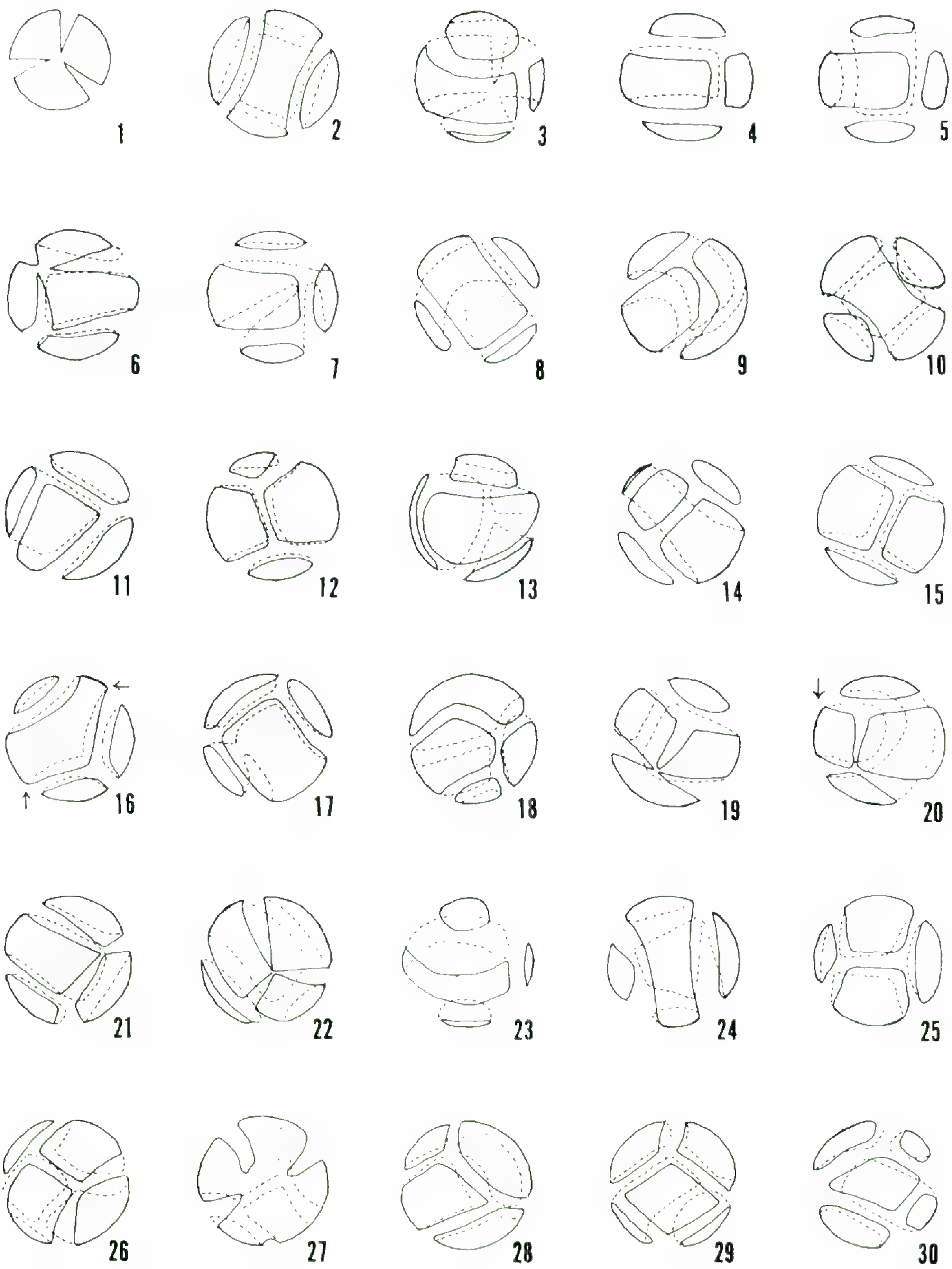
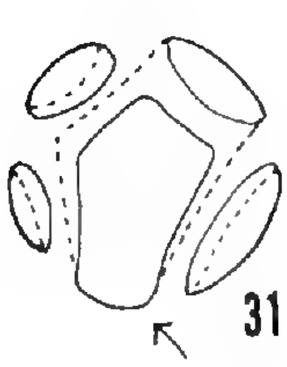


Figs. 1-30. *Stevia* pollen, schematic, spines and pores not shown, arrows indicating possible hidden furrows. 1. Pollen type I. 2-30. Pollen type II. 2-5. *S. alatipes* (*Pringle 10124*, US). *6. S. connata* (*Bourgeau 3243*, US). 7-9. *S. elongata* (*King & Soderstrom 3111*, US). 10-11. *S. monardaefolia* (*Pringle 743*, GH). 12-13. *S. pilosa* (*Berlandier 663*, US). 14-16. *S. purpusii* (*Pringle 11294*, US). 17-18. *S. rhombifolia* (*Palmer 958*, US). 19-22. *S. satureiaefolia* (*Cronquist 9720*, US). 23-24. *S. viscida* (*Palmer 791*, US). 25-29. *S. plummerae* (*Harrison 3054*, US). *30. S. seemannii* (*Seemann 2041*, GH).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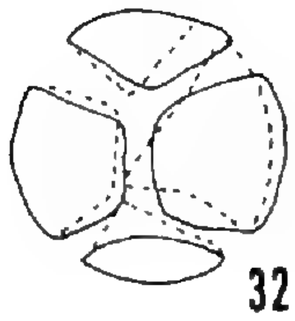
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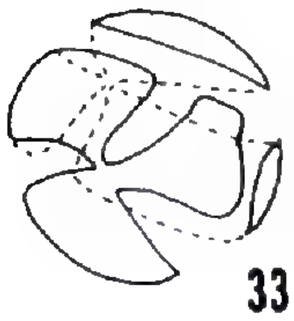
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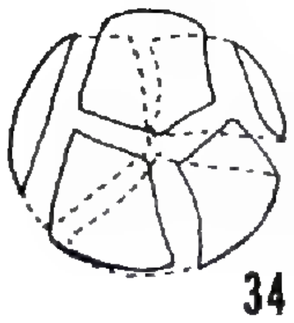
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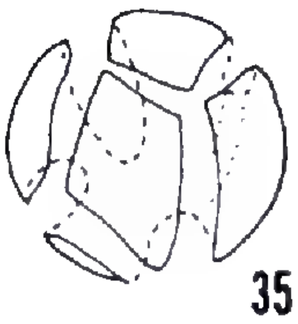
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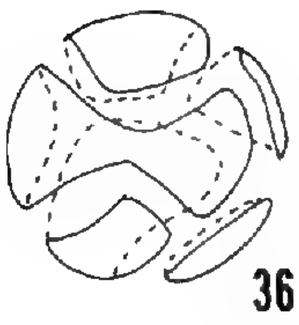
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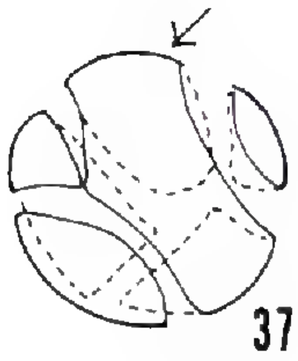
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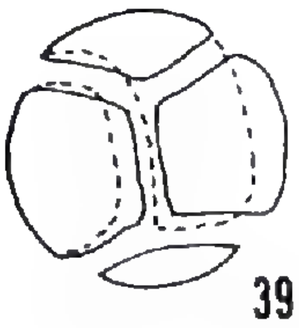
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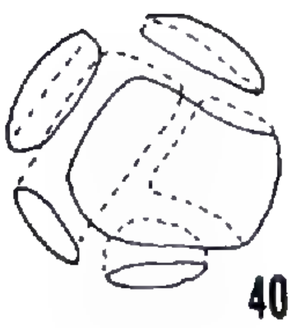
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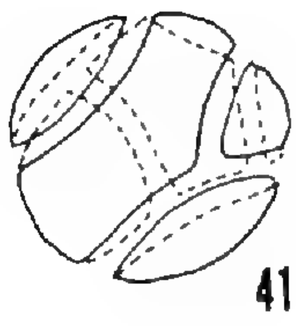
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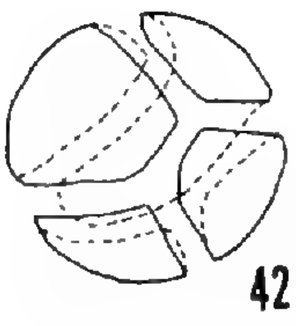
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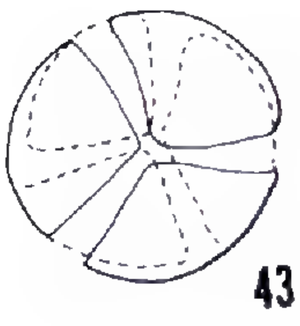
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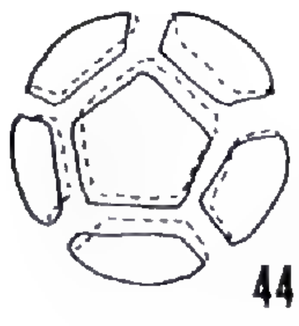
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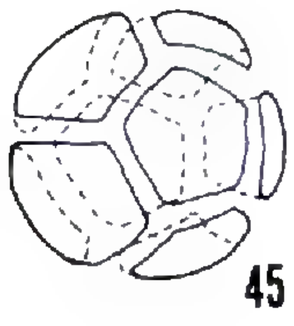
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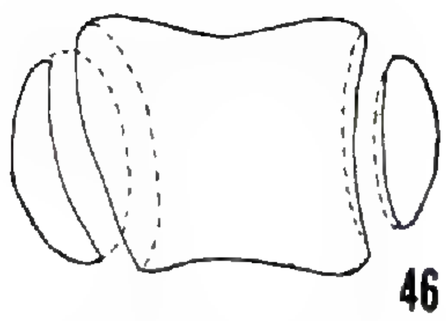
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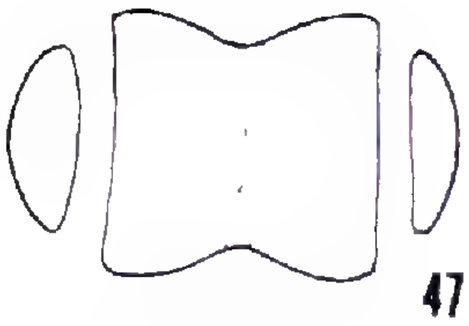
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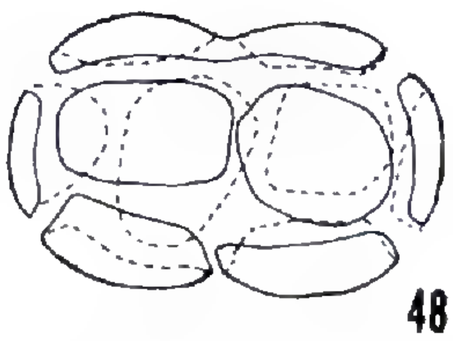
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Figs. 31-48. *Stevia* pollen, schematic, spines and pores not shown, arrows indicating possible hidden furrows 31-45. Pollen type II. 31-32. *S. seemannii* (*Seemann 2041,* GH). 33-35. *S. seemannii* var. *selerorum* (*Seler 1602,* GH). 36-38. *S. tomentosa* (*Seaton 487,* GH). 39-45. *S. micradenia* (*Pringle 5051,* US). 46-48. Pollen type III. 46-47. *S. pilosa* (*Pringle 9547,* US). 48. *S. purpurea* (*Palmer 463,* US).

ADDITIONAL DISCUSSIONS PERTAINING TO THE CONGENERIC STATUS OF PERITYLE AND LAPHAMIA (COMPOSITAE)[1]

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Department of Biology, Sul Ross State College, Alpine, Texas 79830

Various taxonomic dispositions of *Perityle*, *Laphamia*, and segregate genera have been proposed or discussed by Gray (1886), Rydberg (1914), Macbride (1918), Johnston (1941), Everly (1947), Blake (1951), Shinners (1959), and Powell and Tsang (1966). In brief, Rydberg established or recognized several small genera (including *Pappothrix*) with his rather comprehensive treatise of the subtribe Peritylanae, but subsequent workers, especially Macbride and Blake, found it necessary to marshal 6 of the taxa into two more natural categories, *Laphamia* and *Perityle*. Even the generic status of *Laphamia* and *Perityle* has been questioned by Johnston, Shinners, and Powell and Tsang (and others), largely because the two taxa can be distinguished consistently by a single character, the structure of the pappus. Shinners submerged *Laphamia* into *Perityle* with the strong contention that "To uphold *Perityle* as a separate genus solely by the presence of small pappus scales with or without awns (and both structures variable in number and size) seems quite arbitrary." Studies of several Composite genera, for example *Chaetopappa* (Shinners, 1946), *Krigia* (Shinners, 1947), *Lygodesmia* (Shinners, 1950), *Heterotheca* (Shinners, 1951), *Stenocarpha* (Turner, 1965), and *Galinsoga* (Turner, 1966), has indicated that some early interpretations of the importance of pappus differences are subject to re-evaluation, especially when used as a primary criterion to delimit genera. I believe, along with Johnston (1941) and Shinners (1959), that *Perityle* provides another case in point where pappus differences must be evaluated in proper perspective with other overall differences and similarities.

Considerable morphological studies of *Laphamia* and *Perityle* have revealed another semi-consistent character by which the taxa can be delimited. The achene margins of traditional *Laphamia* species are subglabrous to short-pubescent but do not exhibit the relatively long-ciliate condition of most *Perityle* species. The few species of *Perityle* which do not have conspicuously ciliated achene margins are recognizable by the presence of pappus squamellae. If *Laphamia* and *Perityle* are separate monophyletic groups even though closely related, and I believe they are, then their recognition as genera on arbitrary grounds would seem to be justified. However, purely arbitrary designations of taxonomic rank are not necessarily commensurate with phylogeny.

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[1] Supported by NSF Grants GB-2400 and GB-5046.

Detailed morphological discussions are not included here since such comparisons of *Laphamia, Perityle,* and other taxa of this subtribe are presented adequately by most of the authors listed above. Still, morphic criteria provide the best evidence for combining *Laphamia* and *Perityle.* After studying all the *Laphamia (s.str.)* species and many species of *Perityle (s. str.),* it is abundantly clear that these traditional taxa are extremely similar. It has become evident that vestigial pappus squamellae are exhibited by most traditional *Laphamia* species and not the few (notably in *P. castillonii* and *P. dissecta*) mentioned by other authors. When the prominence of pappus squamellae is compared with the presence or absence of bristles in *Laphamia* and *Perityle,* it is very difficult to distinguish typical *Laphamia* features from those present in derived *Perityle* species. Where this situation exists usually it is possible to delimit *Perityle* from *Laphamia* by achene margin pubescence, the former typically with longer and more profuse marginal hairs than the other. However, it is significant to mention that hybrids (see below) and suspected hybrids derived from *Laphamia* and *Perityle* parental species exhibit a pappus and achene pubescence more like the *Laphamia* parent even though a combination of a few other exomorphic features might resemble the *Perityle* parent. This suggests that if much ancestral hybridization has occurred, it would be difficult to detect the origin of intermediate taxa, i.e., those with reduced squamellae. At any rate it seems evident that the use of pappus structure to separate *Laphamia* from *Perityle* is at best tenuous from a phylogenetic point of view. Additionally, it is proper to note that the *Pappothrix* pappus (10-35 bristles) is more distinctive than is that of *Laphamia* or *Perityle* (Rydberg, 1914), but numerous other features seem to prohibit the treatment of *Pappothrix* as a genus.

Also helpful in the morphological comparison of *Laphamia* and *Perityle* is an equivalent conspectus of the related genera *Pericome, Amauria,* and *Eutetras.* It is not possible to present an extensive morphological comparison of these genera here, albeit in summary each shows affinity with *Perityle,* but generic distinctiveness through characters of vegetative and floral habit, achene morphology, and pappus structure. By general morphic comparison, *Pericome, Amauria,* and *Eutetras* contrast more with each other and with *Perityle (sensu lato)* than does *Laphamia s. str.)* with *Perityle (s. str.).* Achene and pappus structure is compared in Figures 1-6. The likeness of *Perityle* and *Pericome* achenes belies a more distant relationship which is seen through a combination of other characters, although *Pericome* is probably closer to *Perityle* than the other genera.

Fortunately, in the case of *Laphamia* and *Perityle,* some evidence other than gross morphological and ecological similarities lends support to congeneric status. Ripley (1957) reported the spontaneous occurrence of hybrids between *P. coronopifolia* and *L. lindheimeri* in a green-

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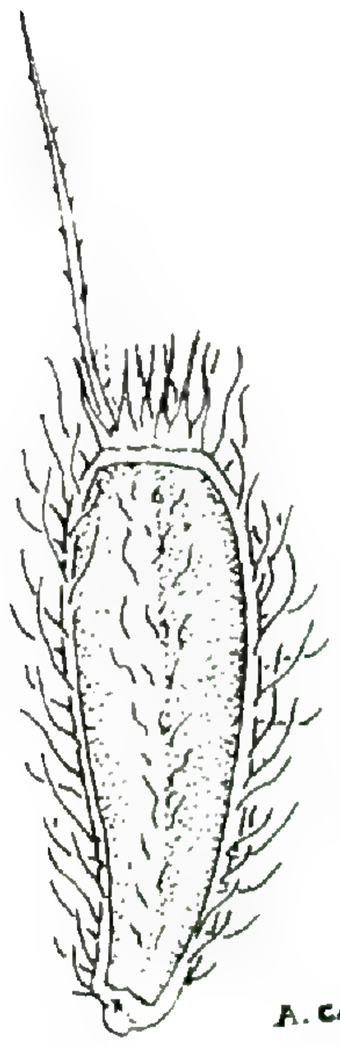

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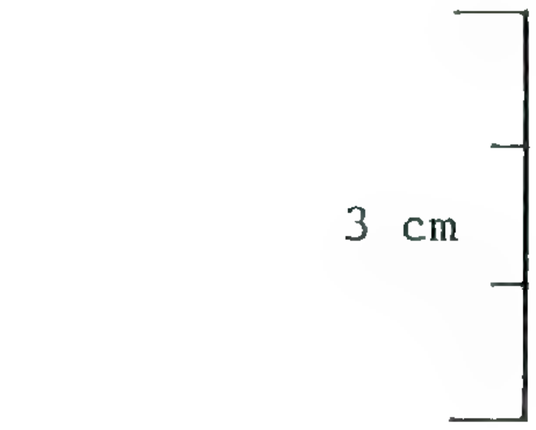

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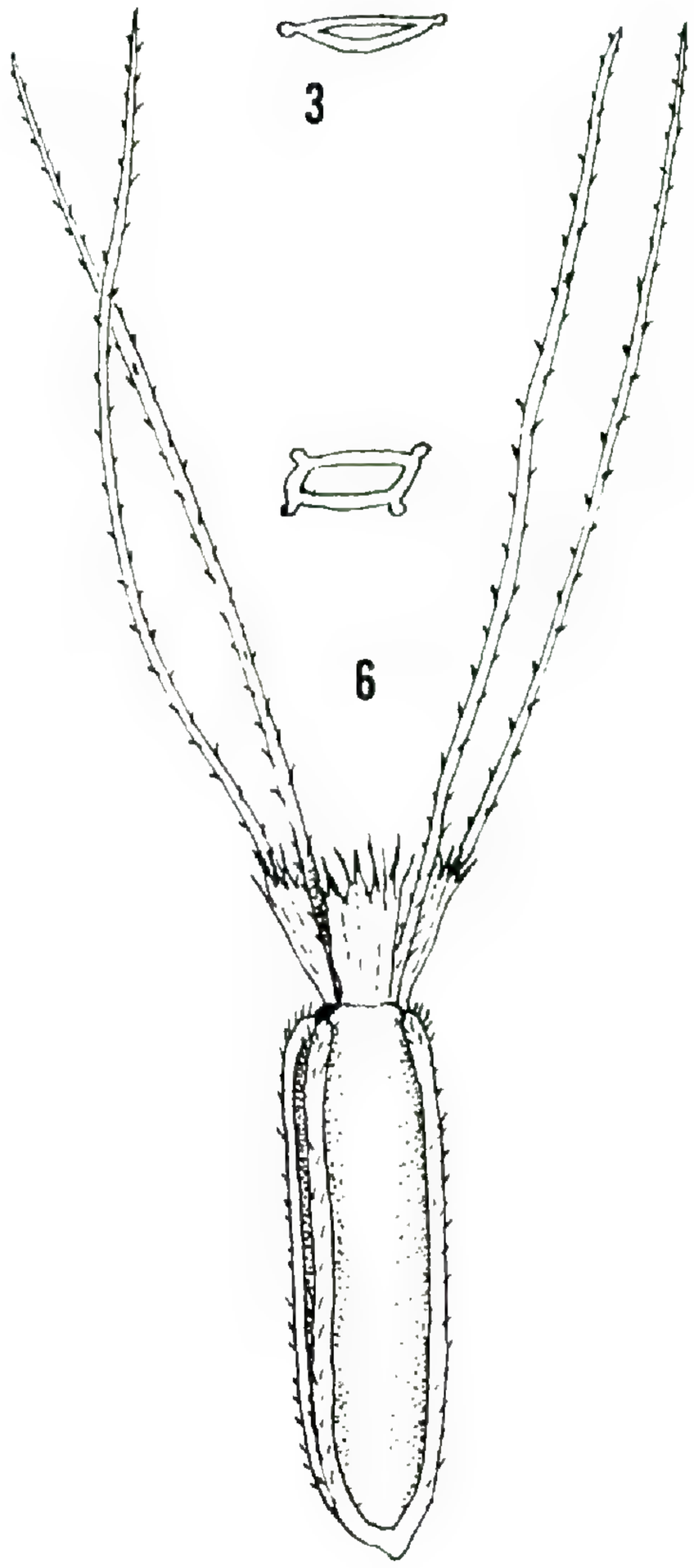

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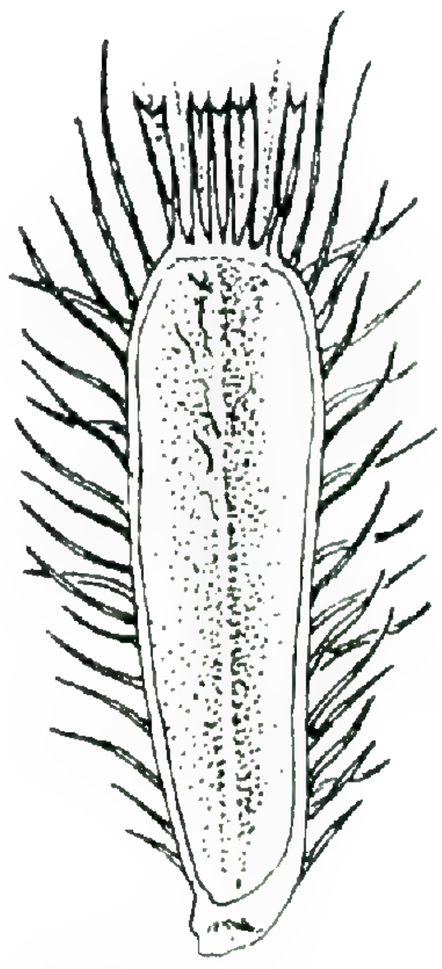


Figures 1-6. Comparative achene and pappus morphology with accompanying cross-sections. Fig. 1. *Perityle rupestris* var. *albiflora* (traditional *Pappothrix)*. **Fig. 2.** *Perityle lindheimeri* var. *lindheimeri* (traditional *Laphamia*). Fig. 3. *Perityle vaseyi.* Fig. 4. *Pericome caudata.* Fig. 5. *Amauria rotundifolia.* Fig. 6. *Eutetras pringlei.*

house in Wappingers Falls, New York (voucher specimen, CAS, 403416). The parental species are not at all closely related, the former being native to southern Arizona-New Mexico and northern Chihuahua, Mexico, and the latter being restricted to the Edwards Plateau of Texas. I have found what appear to be natural hybrids derived from *P. parryi* × *L. rupestris* in the Chisos Mountains of Texas. The small population of putative hybrids seems to represent a fertile, moderately successful "species". Again the parental species involved are very distinct. Studies aimed toward documentation of this suspected hybridization are in progress.

Although experimental attempts to hybridize *Laphamia* and *Perityle* species are still in preliminary stages, there is considerable indication that relatively high interspecific fertility (as determined by seed-set) exists with several species (Fig. 7). While intergeneric and intersectional crosses are more pertinent to this discussion, some infrasectional crosses are presented to show relative fertility. These data are not presented as very definitive evidence at the present stage of investigation, but merely as an indication of trend.

Several limiting factors require that the significance of this interfertility data be interpreted with caution: 1) Fertility is measured only by apparently successful seed-set. Achenes were counted fertile when the pericarps were normally dark in color and seemingly inflated by well-developed embryos. Numerous microscopic examinations showed 100% quasi-normal embryos when achenes "looked fertile" by the above standards. 2) Achene germination, even in "pure" species, is accomplished with moderate success. Although germination of hybrid achenes is neither more nor less successful than germination of achenes taken from plants in the field, one can not be certain whether sterility of hybrid seeds is being expressed at this stage. Also, I have not managed to grow plants of pure species or putative F_1 hybrids beyond the seedling stage. It is presumed that diploid × polyploid progeny would ultimately express greater sterility than diploid × diploid progeny. 3) Several of the interfertility percentages are based on evaluation of 50 achenes or less (with a maximum of 150), and in 3 instances crosses were effected with only one head of florets on the female parent (most notably with *P. gilensis* and *Eutetras pringlei*). 4) Only a small number of species have been utilized for these hybridization tests.

Practically all species examined have shown complete self-incompatability. Mature achenes have developed in control heads of only 3 taxa, *P. angustifolia, P. rupestris* var. *albiflora,* and *P. ruperstris* var. *rupertris* (after examining up to 6000 florets), but the percent of apparent self-compatability has not exceeded 0.34. No control heads were available to test the self-compatability of *P. gilensis* and *Eutetras pringlei.*

Under natural conditions there are few places where species of *Laphamia* and *Perityle* occur sympatrically, therefore, even if general inter-

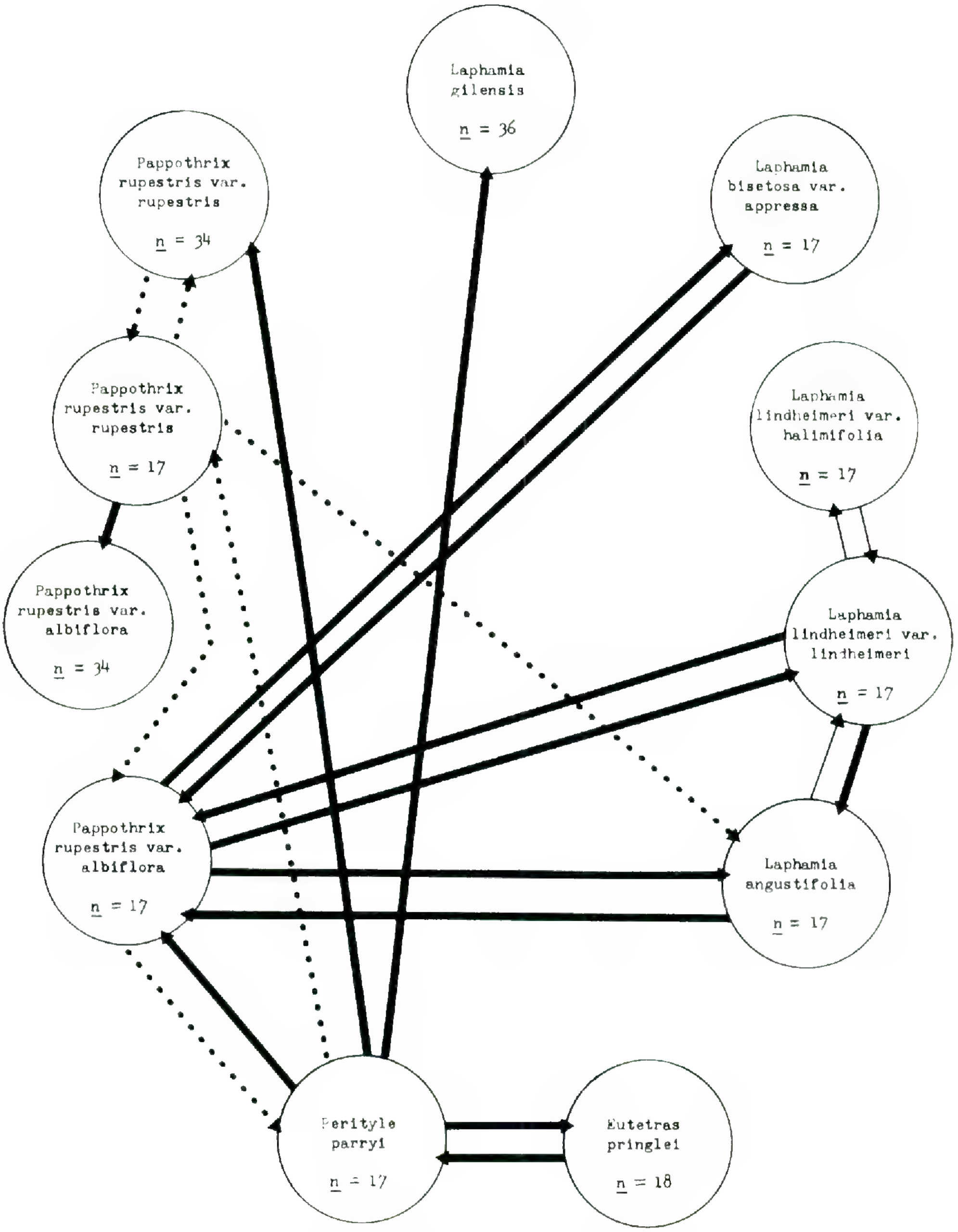

Laphamia gilensis n = 36
Pappothrix rupestris var. rupestris n = 34
Laphamia bisetosa var. appressa n = 17
Pappothrix rupestris var. rupestris n = 17
Laphamia lindheimeri var. halimifolia n = 17
Pappothrix rupestris var. albiflora n = 34
Laphamia lindheimeri var. lindheimeri n = 17
Pappothrix rupestris var. albiflora n = 17
Laphamia angustifolia n = 17
Perityle parryi n = 17
Eutetras pringlei n = 18

Figure 7. Results of preliminary hybridization studies in *Perityle* based on seed-set data only. The traditional generic names *Laphamia* and *Pappothrix* are utilized here to facilitate the evaluation of comparative generic and sectional interfertility. Species formerly placed in *Laphamia* and *Pappothrix* presently are regarded as comprising sections of *Perityle*. The broad lines indicate interfertility above 25 percent, narrow lines indicate very limited interfertility (.22-1.3 percent), and broken lines indicate crosses attempted with no positive results. Female parents of reciprocal and non-reciprocal crosses are designated by arrow points.

fertility exists, the taxa retain their identities in nature. I suspect that hybrids may be found whenever any two species of the taxa in question occur together, providing chromosome ploidy levels are not drastically different.

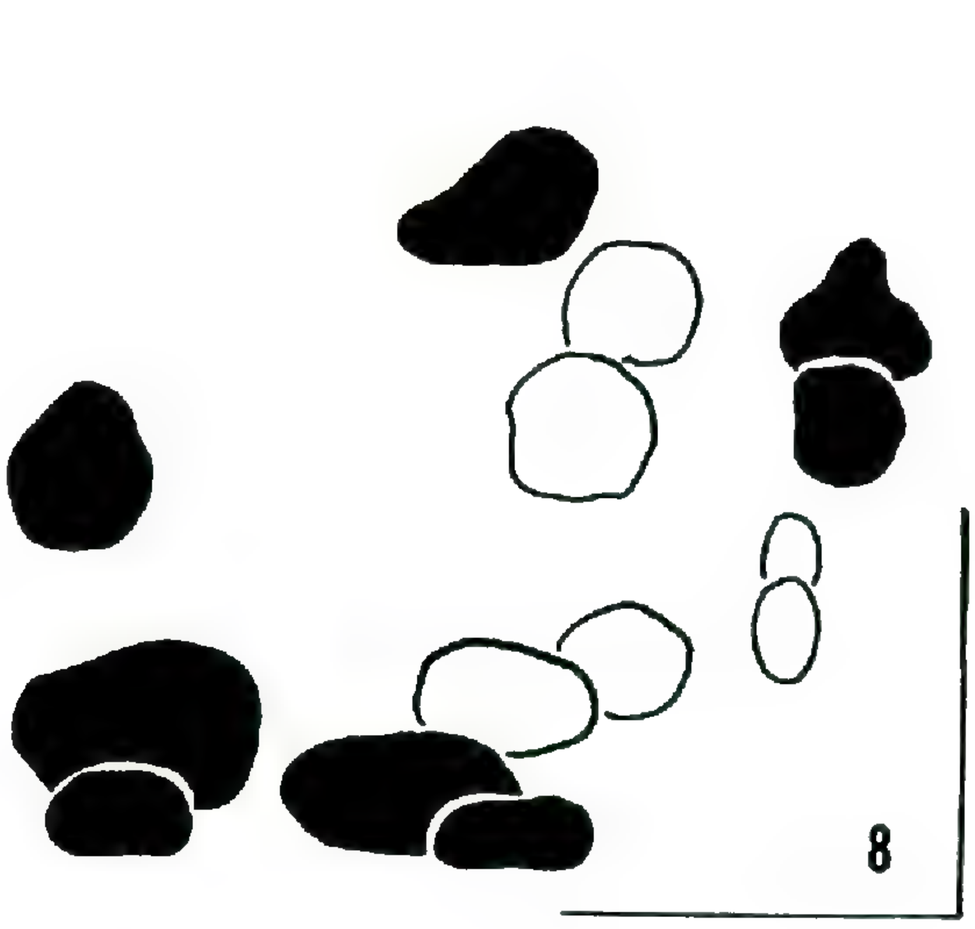
Chemical studies have shown that the 2-dimensional paper chromatographic patterns of *Laphamia* and *Perityle* species are very much alike (Powell and Tsang, 1966; Figs. 8-10). Also, it is possible to distinguish such related genera as *Pericome, Amauria,* and *Eutetras* by their chromatographic patterns (Figs. 11-13). Techniques for developing the chromatograms in general follow those outlined by Alston and Turner (1963).

Figures 8-13 are tracings of patterns taken from the chromatograms of species which were selected arbitrarily to represent the proposed sections of *Perityle* and the three related genera. The *Pappothrix, Laphamia,* and *Perityle* patterns were chosen because of the number of compounds the particular representative species share. Spots depicted here as common to each section are not necessarily shared by the species used to show representative compounds, but other species of the same section do produce the common spots. Actually all 5 species of Sect. *Pappothrix,* 17 species of Sect. *Laphamia,* and 16 species *of* Sect. *Perityle* have been examined chromatographically, and the chemical variability of these taxa is not at all apparent in Figs. 8-10. As indicated elsewhere (Powell and Tsang, 1966), virtually every species can be distinguished by its chromatographic pattern, although some are quite similar. Sectional or generic chemical profiles are not presented because such comprehensive assessments are possible only for Sect. *Pappothrix* at this time. Figures 8-10 emphasize what are believed to be common compounds so that close chromatographic relationship can be visualized.

For the purposes of this presentation, the evaluation of common and unique compounds has resulted from the examination of chromatograms under long wave ultra violet light, with and without the presence of ammonia vapor. Determinations were based on the relative positions of spots on chromatograms, their color, and their color changes under the above conditions. The major components have been identified as flavonoids, (Powell and Tsang, 1966) but no specific chemical characterizations have been accomplished.

Just two species are known for *Pericome, Amauria,* and *Eutetras.* One species of *Pericome* has been examined chromatographically. Both species of *Amauria* and *Eutetras* have been sampled, and each produces a distinctive chromatographic pattern. Figures 11-13 emphasize what are believed to be unique compounds so that generic differences of chromatographic patterns can be gauged.

The simple pattern data referred to here certainly do not represent demanding evidence for the congeneric status of *Laphamia* and *Perityle,* but the chemical similarity between these two genera does emphasize their essential unity especially as compared with related genera.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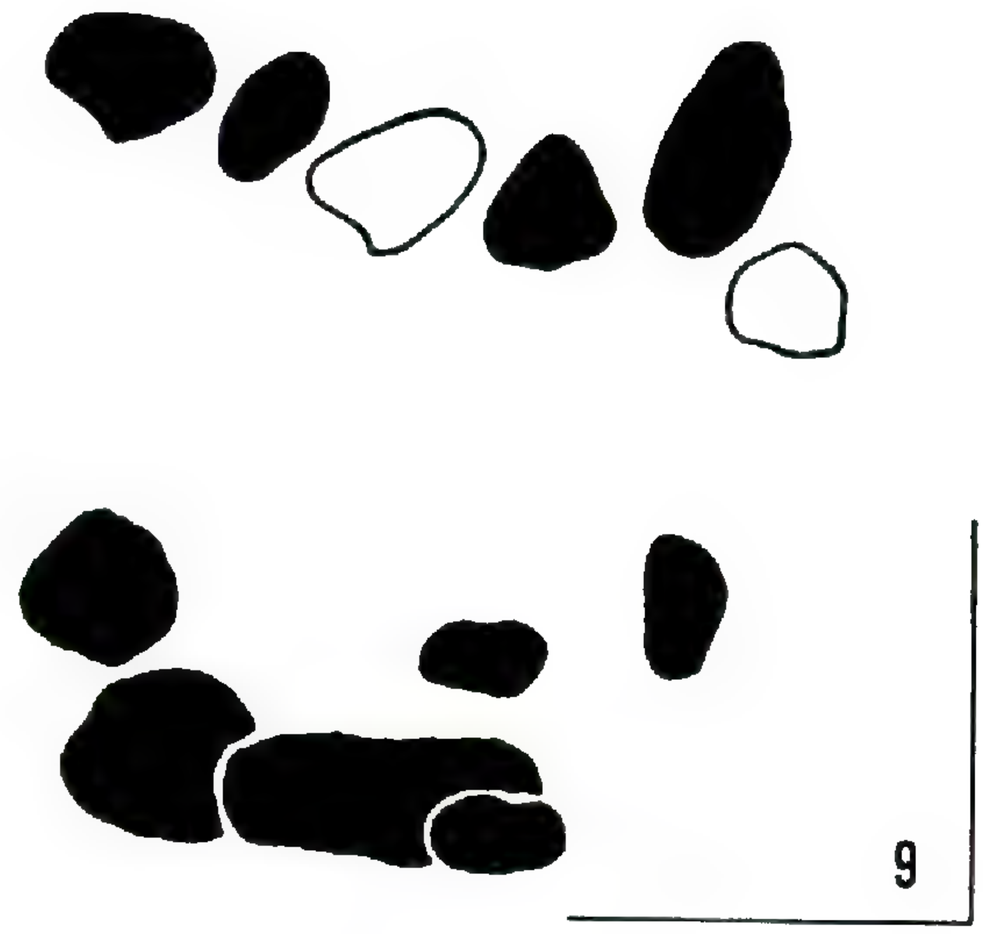
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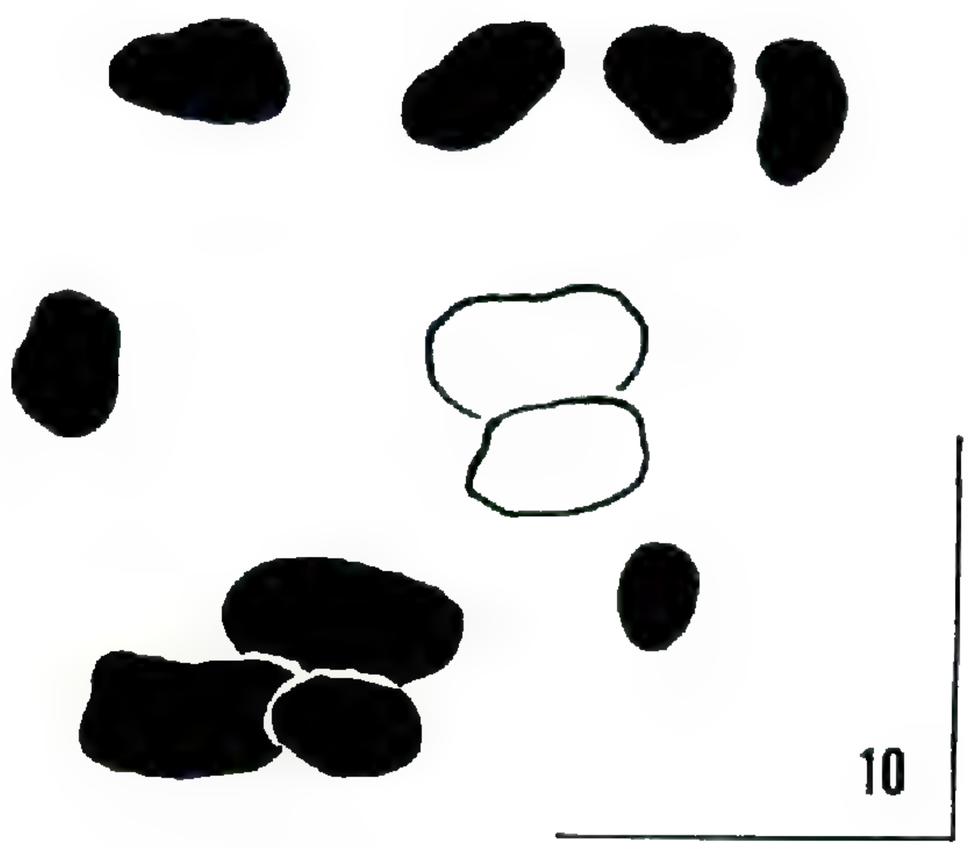
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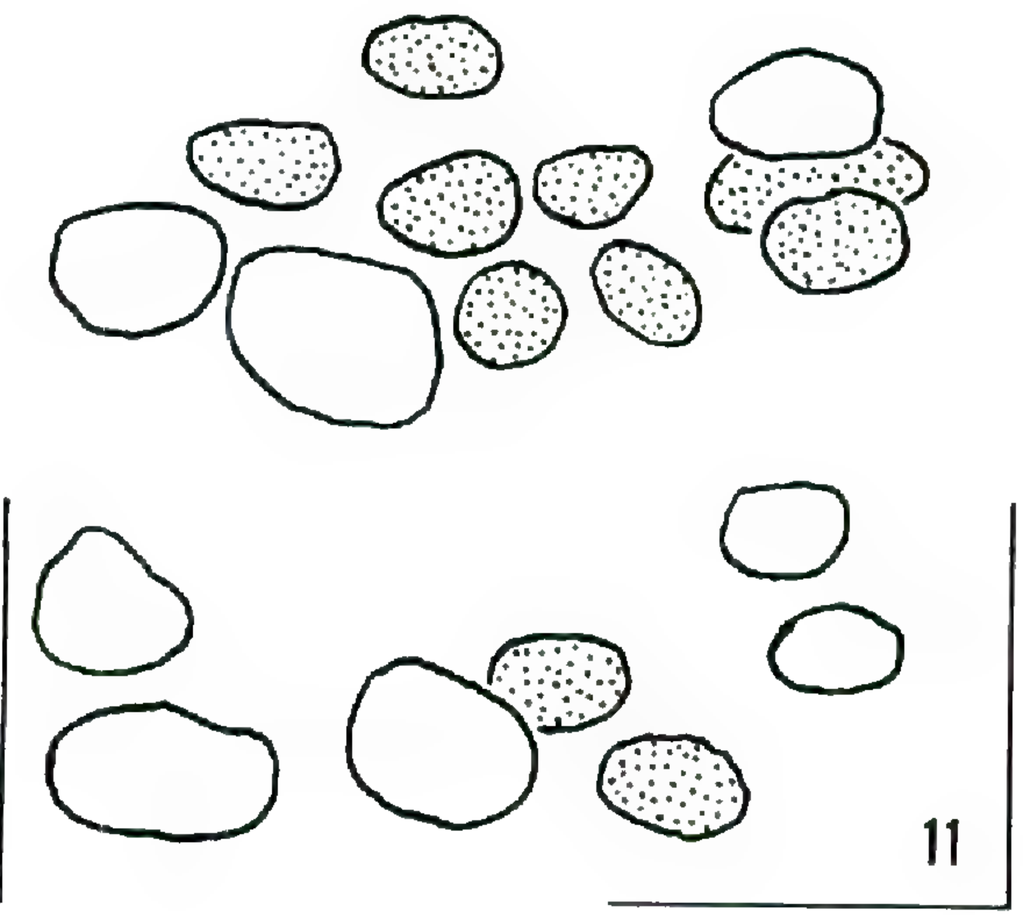
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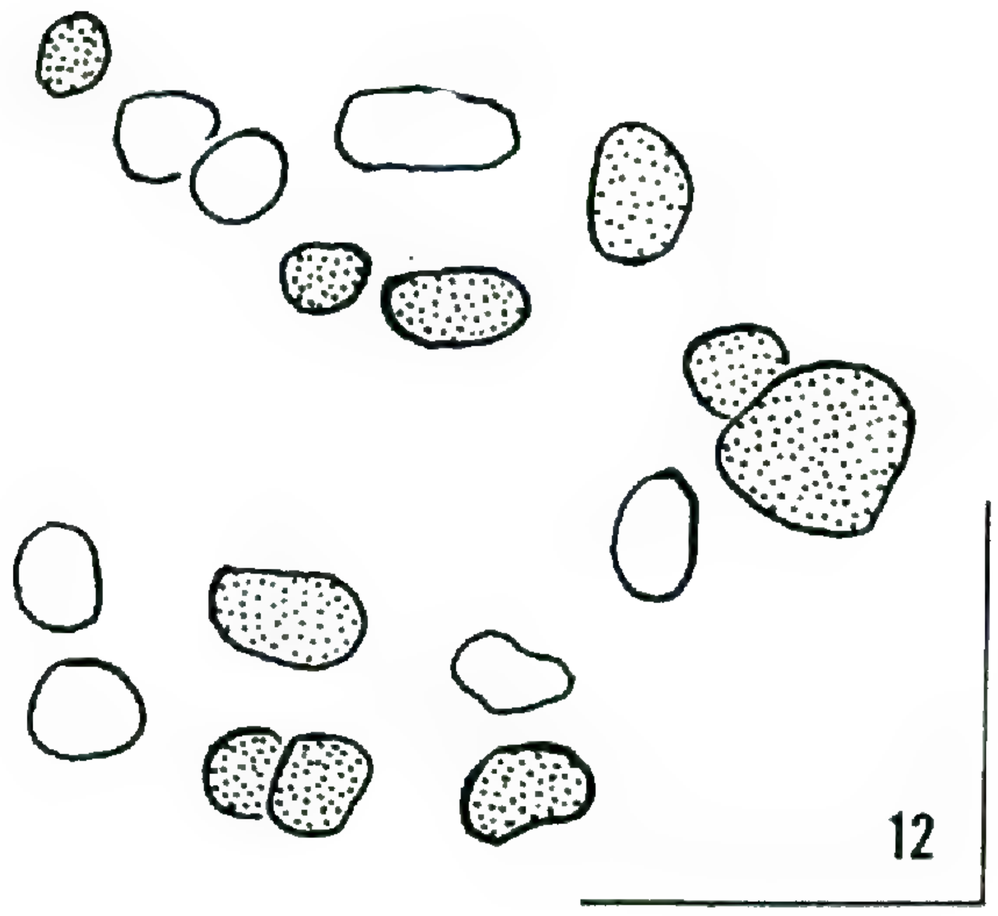
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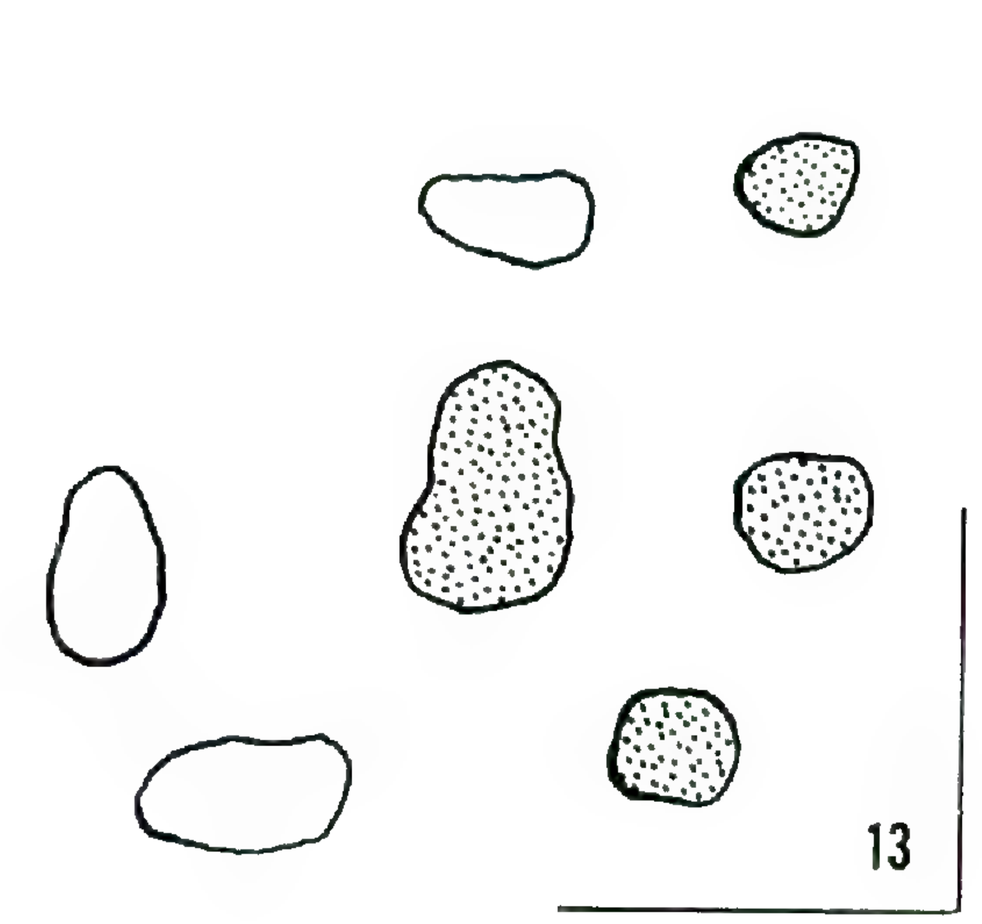
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Perhaps most important is the chemical comparison of the proposed Sect. *Pappothrix* (traditional *Laphamia)* with other *Laphamia* and *Perityle* species. The cumulative chromatographic profile of *Pappothrix* is every bit as different as is that of *Perityle* from *Laphamia*, even though the chemistry of all three groups of species is similar. And, as mentioned above, in spite of the unique *Pappothrix* pappus type, the similarities of this group to other *Laphamia* are so overwhelming that one can not consider *Pappothrix* as a genus. Additional chemical evidence, with appropriate taxonomic discussions, will be presented elsewhere (Powell, unpublished).

Evidence regarding the generic relationships within subtribe Peritylanae is being accumulated, but at present it seems clear that the treatment of *Laphamia* and *Perityle* as a single genus is most desirable. Accordingly, it is necessary to make appropriate nomenclatural changes at this time in order to facilitate taxonomic preparations.

Morphological and chemical evidence suggest the recognition of three subgeneric groups within *Perityle*. These are as follows:

PERITYLE Sect. PAPPOTHRIX A. Gray, Pl. Wright. 1: 100. 1852.

TYPE: *Laphamia rupestris* A. Gray.

Pappus of (10) 20-35 bristles; achenes flattened to nearly cylindric, but typically 2-4 angled, margins not strongly calloused, margins subglabrous to short-pubescent.

PERITYLE Sect. **Laphamia** (A. Gray) Powell, comb. nov.

Laphamia A. Gray, Pl. Wright. 1: 101. 1852.

TYPE: *Laphamia lindheimeri* A. Gray.

Pappus absent or of 1-2 (3) bristles, often with inconspicuous, vestigial squamellae; achenes flattened, margins conspicuously to inconspicuously calloused, margins subglabrous to short-pubescent.

PERITYLE Sect. PERITYLE.

TYPE: *P. californica* Benth., Bot. Sulph. 23. 1844.

Pappus a crown of laciniate, hyaline squamellae and 0-2(3) bristles; achenes flattened, margins conspicuously to inconspicuously calloused, margins typically strongly ciliate, rarely short-pubescent.

Figures 8-13. Representative chromatographic patterns of the proposed sections of *Pyrityle* and related genera. Fig. 8. *P. vitreomontana* (Sect. *Pappothrix*). Fig. 9. *P. congesta* (Sect. *Laphamia*). Fig. 10. *P. vaseyi* (Sect. *Perityle*). Darkened spots depict compounds which are believed to be produced in common by the various species of all 3 sections of *Perityle*. Fig. 11. *Pericome caudata*. Fig. 12. *Amauria rotundifolia*. Fig. 13. *Eutetras pringlei*. Stippled spots depict compounds which are believed to be unique for the respective genera. Numbers (8-13) which denote the respective figures are placed at the point where extracts were applied to chromatograms.

I propose the following ccmbinations to complete the record of known species transferred to *Perityle* Benth.

PERITYLE LINDHEIMERI (A. Gray) Shinners var. **halimifolia** (Gray) Powell, comb. nov. *Laphamia halimifolia* A. Gray, Pl. Wright. 1: 100. 1852. *P. halimifolia* (A. Gray) Shinners, Southw. Natl. 4: 204. 1959.

PERITYLE **cinerea** (A. Gray) Powell, comb. nov. *Laphamia cinerea* A. Gray in Torr. Bot. Mex. Bound. 82. 1859. *Pappothrix cinerea* (A. Gray) Rydb. N. Amer. Fl. 34: 27. 1914.

PERITYLE **inyoensis** (Ferris) Powell, comb. nov. *Laphamia inyoensis* Ferris, Contrib. Dudley Herb. 5: 104. 1958.

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TURNER, B. L. 1966. The taxonomic status of *Stemmatella* (Compositae-Heliantheae). Madroño 18: 203-206.

NOTES

ACACIA TORTUOSA (LEGUMINOSAE) NEW TO FLORIDA.—During recent work on the Leguminosae of Florida several supposedly well-understood genera have been found to be represented in the state by species not previously reported for the Southeast. *Acacia* has contributed two: *A. macracantha,* a West Indian and Central American tree recently found well established and perhaps native in the Florida Keys (Brittonia 19:283-284. 1967), and now a second, *A tortuosa.*

Acacia tortuosa (L.) Willd. is a small tree of the West Indies, Mexico, and southern Texas. It is related rather closely to the even more widespread and generally much more common Sweet Acacia, *A. farnesiana,* but is readily distinguished by the longer, more slender fruits constricted between the seeds, suggestive of those of *Capparis flexuosa.*

Two stations have now been located for this species in Florida, both along the coast of Collier County in the southwestern part of the state. Representative collections are as follows: Dry shell island, Chokoloskee. *Eleanor Scull,* 5 June 1937 (FLAS); Slope of shell mound, Chokoloskee Island. *D. B. Ward 6021* (DUKE, FLAS, FSU, GA, GH, NCU, NY, US, USF); Ferguson River shell mounds. *F. C. Craighead,* 28 June 1960 (FLAS). At both of these stations the plants are well established, although at Chokoloskee the population size is only a fraction of that of the ubiquitous *A. farnesiana.* At this station the *A. tortuosa* forms small (to 4 meters), much-branched, flat-topped trees, with the branches seemingly coarser than those of adjacent *A. farnesiana* of the same height, thereby permitting the plants to be distinguished at a distance with little error.

It is notable that all Florida collections have come from shell mounds, a substrate deposited by man, thus the habitat is in no sense to be considered "undisturbed." Whether this species was of value to the aboriginal Caloosas, perhaps for their marginally edible fruits, and thus a pre-Columbian introduction from the West Indies, or whether the plants became established in relatively recent times by natural means, remains an open puestion.

A total of five species of *Acacia* is now known to grow in Florida under natural conditions, and the following key, based on Florida materials, is suggested for their separation.

1a. Herbaceous or suffrutescent; flowers white (rarerly pinkish); leaves lacking glands on both petiole and rachis; pods flat.
A. angustissima (Mill.) Kuntze var. *hirta* (Nutt.) Robins. (= *Acaciella hirta* (Nutt.) Britt. & Rose)

1b. Woody, shrubs (often low in *A. pinetorum*) or small trees; flowers

yellow or orange; leaves with a gland or glands on upper surface of petiole or both petiole and rachis; pods terete or compressed, but never flat.

2a. Pods clearly compressed laterally; leaves with 14-20 pairs of pinnae; prominent craterform gland present between terminal pair or pairs of pinnae.

A. macracantha Humb. & Bonpl. ex Willd. (= *Acacia macracanthoides* Bert. in DC.; *Acacia lutea* (Houst. ex Mill.) Hitchc., not *A. lutea* Leavenw.)

2b. Pods terete or nearly so; leaves with 4-8 pairs of pinnae; inconspicuous disciform gland present between terminal pair of pinnae, or absent (although present on petiole).

3a. Pods somewhat constricted between the seeds, glabrate or with a dense, granular pubescence, 8-10 cm. long.

A. tortuosa (L.) Willd.

3b. Pods uniform in thickness, glabrous, 4-8 cm. long.

4a. Leaflets 1.5-3 mm. long, without (or with very obscure) lateral veins; pod with suture not apparent, blunt or long tapering; spines slender, 8-12 mm. long.

A. pinetorum Hermann (= *Vachellia peninsularis* Small, not *Acacia peninsularis* (Britt. & Rose) Standley; *Vachellia insularis* Small, not *Acacia insularis* A. Rich.)

4b. Leaflets 3-6 mm. long, with 1-6 prominent lateral veins; pod with two low ridges paralleling suture, usually blunt; spines moderately stout, usually either ca. 5 mm. long or ca. 25 mm. long.

A. farnesiana (L.) Willd. (= *Vachellia farnesiana* (L.) Wight & Arn.; ?*Vachellia densiflora* Alexander in Small, not *Acacia densiflora* Morrison)

I am grateful to Dr. Velva Rudd, Washington, D.C., for her observations on my earlier manuscripts of this group, from which the above key is derived.—*Daniel B. Ward, University of Florida, Gainesville, Florida 32601.*

ANODA CRISTATA (MALVACEAE) IN FLORIDA.—In the fall of 1965, Dr. Walter Scudder, of the Central Florida Experiment Station, Sanford, brought an interesting group of vegetable farm weeds to Gainesville for identification. One of these (collected 16 Sept. 1965 at Zellwood, Orange County; specimens deposited in the Herbarium of the Agricultural Experiment Station, University of Florida, was an unusual

looking member of the Malvaceae, which I could not match up with any of the known Florida representatives of the family. Floras of adjacent regions soon pinpointed it as *Anoda cristata* (L.) Schlecht., a widespread tropical American weed that ranges north into the southwestern U. S. It has turned up at scattered points in the eastern U. S., the nearest record to Florida being Mecklenberg County, North Carolina. Dr. Scudder reports having seen colonies of it in truck-farming areas at several localities in Orange and Seminole Counties. His specimens represent the var. *digitata* (Gray) Hochr., with lobed leaves, a weak variant first found in southern Arizona.—*John Beckner, Research Associate, Department of Botany, University of Florida, Gainesville, Florida 32601.*

RHODODENDRON PRINOPHYLLUM (R. ROSEUM, ERICACEAE) IN NORTH CAROLINA—A 1965 collection of *Rhododendron prinophyllum* (Small) Millais, on the summit of Bluff Mountain, Ashe County, North Carolina, apparently constitutes the first record of the species in the Carolinas. At the Bluff Mountain station it is associated with a mixed-oak forest (*Quercus rubra* L., *Q. rubra* var. *borealis* (Michx. f.) Farw., and *Q. alba* L.) at elevations above 4000 feet. *Rhododendron catawbiense* Michx. and *R. calendulaceum* (Michx.) Torr. are co-dominant shrubs.

Rhododendron prinophyllum is known as *R. roseum* (Loisel.) Rehder in current floras. Shinners, however, has shown the illegitimacy of *R. roseum* (Castanea 27:94-95).

The azaleas have long been a poorly understood group, and little reliance should be placed on distribution data as given in the older publications in the absence of voucher specimens. Early workers (Robinson and Fernald, *Gray's New Manual of Botany,* 7th edition, 1908) did not distinguish the plant now known as *R. prinophyllum* from *R. canescens* Michx. It was also sometimes confused with *R. periclymenoides* (Michx.) Shinners, a species incorrectly called *R. nudiflorum* (L.) Torr. in current works. As monographed by Rehder (in Wilson and Rehder, *A Monograph of Azaleas,* 1921), however, *R. prinophyllum* is separable from both species.

W. W. Ashe ("Azalea in North Carolina," Jour. Elisha Mitchell Sci. Soc. 38:90-91) included *R. roseum* in his list of species said to grow in North Carolina; however, he gave neither ecological nor distributional information. A thorough search of the NCU herbarium, the repository of the bulk of North Carolina specimens collected by Ashe, has failed to reveal any specimens from North Carolina identifiable as *R. prinophyllum.* The species was not included in the recent *Guide to the Vascular Flora of the Carolinas* (Radford et al, 1964).

Collection data for this report are as follows: NORTH CAROLINA, Ashe Co.: Bluff Mountain, mixed-oak forest above bog and fen area,

16 May 1965, G. E. Tucker 2225 (flowers); 26 July 1965, G. E. Tucker 2886 (fruits). Specimens are deposited at SMU and NCU.—*G. E. Tucker, Biology Department, Arkansas Polytechnic College, Russellville, Arkansas 72801.*

CALYSTEGIA SEPIUM VAR. FRATERNIFLORA (MACKENZIE & BUSH) SHINNERS, COMB. NOV. (CONVOLVULACEAE).—Based on *Convolvulus sepium* var. *fraterniflorus* Mackenzie & Bush, Man. Fl. Jackson Co. Missouri p. 153. 1902. *C. fraterniflorus* Mack. & Bush, Ann. Rept. Mo. Bot. Garden 16: 164. 1905. *Calystegia fraterniflora* (Mack. & Bush) Brummitt, Ann. Mo. Bot. Garden 52: 216. 1965. This new combination is needed for an account of the family being contributed to the forthcoming manual of the vascular flora of Texas by Donovan S. Correll and Marshall C. Johnston.—*Lloyd H. Shinners.*

MACVAUGHIELLA KING & ROBINSON, NOMEN NOVUM FOR SCHAETZELLIA SCH.-BIP., NOT KLOTZSCH (COMPOSITAE).—In 1850 Schultz-Bipontinus described the genus *Schaetzellia* with the species *S. mexicana* from Veracruz. In his discussion, he indicated that the name *Schaetzellia* had been used previously by Klotzsch for a Colombian species which had proved to belong to the genus *Isotypus* H.B.K. (*Onoseris* Willd. emend. DC.). Schultz was careful to indicate that he had the permission of his friend Prof. Dr. Klotzsch to reuse the name. Present rules of nomenclature, however, do not allow such reuse, with or without permission. The new name is intended to honor Dr. Rogers McVaugh of the University of Michigan, who has contributed so greatly to the knowledge of the Mexican flora.

Macvaughiella R. M. King and H. Robinson, nom. nov. *Schaetzellia* Sch.-Bip., Flora 33: 419. 1850. Not *Schaetzellia* Klotzsch, Allgemeine Gartenzeitung 1849: 82. 1849.

Two species are presently recognized in the genus: MACVAUGHIELLA **mexicana** (Sch.-Bip.) R. M. King and H. Robinson, comb. nov. *Schaetzellia mexicana* Sch.-Bip., Flora 33: 419. 1850.—MACVAUGHIELLA **standleyi** (Steyermark) R. M. King and H. Robinson, comb. nov. *Schaetzellia standleyi* Steyermark, Publ. Field Mus. Nat. Hist., Bot. 23: 107. 1944.

Steyermark distinguished his species primarily by the more truncate bases of the leaf blades and the pubescent rather than glabrous involucral bracts. Material seen from Guatemala, Honduras, and El Salvador in the U. S. National Herbarium shows mostly cuneate bases of the leaves and other characters as in *M. mexicana*. The pubescence of the involucre, however, does seem consistently different.—*R. M. King and H. Robinson, Department of Botany, Smithsonian Institution, Washington, D.C. 20560.*

ECHINACEA SIMULATA R. L. McGREGOR, NOM. NOV. (COM-

POSITAE).—Based on *Echinacea speciosa* McGregor, Trans. Kans. Acad. Sci. 70:366, 1968. Not *E. speciosa* (Wenderoth) Paxton, Paxton's Bot. Mag. 15:79, 1849. I am indebted to Dr. Lloyd H. Shinners for so promptly bringing my error to my attention.—*R. L. McGregor, Department of Botany, University of Kansas, Lawrence, Kansas 66044.*

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COMMANDMENTS FOR COMMUNICATION

DUANE ISELY
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Most scientific papers are monotonously unexciting. Their authors conduct carefully planned experiments. The conclusions and hypotheses are supported by data. The written reports are concise, lucid and desiccated. All scientific journals contain numerous examples of such middle class mediocrity.

It is possible to break the strait-jackets of conventionality and provide tingles of expectation and excitement for journal editors and readers. Through development of appropriate skills, the writer may be able to vastly enhance his reputation. Granted the novice is often inept. But with practice and devotion to duty he may succeed in engendering the necessary perception and technical virtuosity.

The procedures are relatively simple. An annotated enumeration follows.

1. *Publish quickly.* Preliminary experiments have provided some ideas. Get them in print. If follow-up work needs to be done to complete the experiment, or to satisfy the skeptics, this can be conducted later. It will yield additional titles for your publication list.

2. *Recognize that writing is unimportant* to a scientist. Writing is the sphere of Professors of English, and those who prepare advertising copy. The primary responsibilities of a scientist end when he comes out of the laboratory.

3. *Go easy on literature.* Do not read publications relating to your undertaking. This requires time that could better be used otherwise. In any event, most investigations completed more than five years in the past are valueless (unless, of course, they were done in your laboratory).

4. *Ignore journal format.* Most journals publish in each issue a set of recommendations for prospective authors. These usually represent an expression of the eccentricities of the editor and improperly inhibit freedom of expression of authors.

5. *Master the mechanics of paper preparation.* It is conventional to have a manuscript typed. If it is single-spaced it will save paper. If changes need to be made, write them in the margins. Inconsistencies in headings, figure and table format, and in citations add variety and spice. Use abbreviations of your own invention; these help in providing a personal touch. Above all don't verify literature citations. It is best to leave some of them incomplete. Most readers of scientific papers are graduate students who need experience in library searching.

6. *Consider means of effective writing.* (If this isn't your meat, place emphasis instead on tables and figures—commandment no. 7).

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There are scientists who actually like to write and whose exceptional qualities are best revealed in the written word. The basic objective is to keep the reader fooled as long as possible.

If possible dispense with organization as formulized by headings such as "materials and methods," "observations," etc. However, a skillful writer can prepare a paper which complies with organizational etiquette and yet has no point whatsoever. Perhaps this is beyond most of us. But some helpful hints:

Use similar headings for various levels of content categories. Present some of the "observations" under "materials and methods" and again in the "discussion." Repeat in the summary exactly what was said in the "observations" so as to provide proper emphasis.

Avoid limiting a paragraph to a single idea or sequence of ideas, but change subject two or three times in the same paragraph. Then, three paragraphs down, go back to one of the first topics again.

The use of definitive grammar and spelling is not improper. However, it is more important that you be yourself. Do not be inhibited by restrictive regulations. Write as you would speak.

Much has been said about brevity or the lack of it. Turn to page 3 of the Style Manual for Biological Journals (1) where a throbbing paragraph has been editorially burned to a shriveled cinder. The soul of the author is gone!

7. *Don't neglect tables and figures.* One of the frequent byproducts of research is the accumulation of a lot of numbers which represent the results of counting or measuring. We call these numbers data. Something has to be done with them. The usual procedure is to stack them into piles and stuff them into tables.

If you are a hungry data hunter, tables are really for you. The best are many-columned, each with its neat rows of little figures; they have a pleasantly hypnotic effect. Be sure to present the original data, not summaries. However, statistical or mathematical embroidery following pages of numbers adds sophistication and ultimate finality to one's endeavors.

The artistic possibilities of figures possessing numerous wavy lines, intersecting bars, and amorphous spots are limitless. Some authors like the homey feeling of figures prepared on second hand graph paper and lettered by hand.

8. *Consider alternatives in data interpretation.* Commandment no. 7 dealt with the disposal of data in conveniently accessible tables. This should constitute a reasonable end to the matter. However, many workers insist that verbal mauling of the bulging tables is essential. There are several attractive procedures available to the disciplined scientist.

(a) The simplest gambit is to ignore the tables. Proceed with a learned and philosophical consideration of your conclusions but don't refer to the data. This might confuse the reader. Indeed, possibly it might confuse you and this should be avoided.

(b) Or, meet the data head on. This is the best alternative for no-

nonsense, pragmatic individuals. For example: Table 11 indicates a germination of 87% of dodder seed at an alternating 20-30°C. with light. One can call attention to this fact in the observations, and repeat the statement in the discussion and conclusions. In this manner, the point is driven home. Likewise for the other seed kinds in Table 11, and likewise for Table 12, etc. It is unwise, however to consider Tables 11 and 12 in relationship to one another, or with respect to broader problems.

(c) In any event, draw definite conclusions. A conclusion is only as good as the vigor of its enunciation. Do not consider the possibility that more than one hypothesis may have validity for the information available (or, Heaven forbid, an insufficiency in experimental design nullifying the possibility of a clear conclusion). An illustration of the relationship between observations and conclusions follows:

My neighbor used to own a small dog that loved to chase butterflies. One day, a butterfly flew across the street and the dog went after it. He was hit by a car. He was laid up but recovered. Thereafter, he was deathly frightened of butterflies and would flee screaming whenever he saw one.

(d) The most courageous way of dealing with data is simply to do without it. Data often unduly prejudice readers and hinder a clear exposition. Again an example: I have recently read an excellent book on evolution by one of our most distinguished geneticists (2). Throughout the book, he develops a meticulous pattern of argumentation based upon accumulated data of genetics, taxonomy, evolutionary theory, etc. His imaginative speculation is carefully related to such data. However, in the last chapter dealing with human evolution, he lets himself go. He discusses the relative evolutionary potentialities of various attributes of human beings. For example he considers the reproductive rates of beautiful and less beautiful women. He states, "Beautiful women do not on the average have the most children, largely because of competing interests of stage, screen and promiscuous manhunting." The elegance of this thought-provoking statement is its apparent freedom from any kind of organized data. Scientific literature is replete with such assertions, albeit most of them on less interesting topics.

9. *Avoid manuscript reviews.* Some authors are worry-warts. They scan their completed manuscript again and again, and annoy their colleagues with requests for suggestions. This is a wasteful procedure that betrays lack of self-confidence. Besides alienating your friends, it delays publication. When the thing is done, it's done. Move on!

Unfortunately many institutions require examination of manuscripts by a review committee before they are submitted for publication. Most journals have review panels. There is nothing an author can do about this; he can only endure patiently. Some reviewers take the time to make numerous suggestions. These can quietly be placed in the circular file.

10. *Publish.* We have gone full circle. Our first commandment was to publish. So is the last. Publication is the mark of achievement in the scientific world. Another citation for the list and another reprint for distribution. Rapid and continuous publication is essential for professional

growth, status with grant foundations, and standing in the community. And it is alleged that St. Peter examines the publication list of all defunct scientists.

LITERATURE CITED

1. CONFERENCE OF BIOLOGICAL EDITORS, COMMITTEE ON FORM AND STYLE. 1964. Style manual for biological journals. Second edition. American Institute of Biological Sciences, Washington, D.C.
2. Citation furnished on request.

TRILLIUM GRACILE (LILIACEAE), A NEW SESSILE-FLOWERED SPECIES FROM EASTERN TEXAS AND LOUISIANA[1]

JOHN D. FREEMAN[2]

TRILLIUM GRACILE sp. nov.

Ex affinitate *T. viridescentis* Nutt. et *T. ludoviciani* Harbison, utraque contiguam aream geographicam occupans, ab utroque floribus minoribus, sepalis recurvis leniter prope medium, petalis brevioribus (plerumque atro-purpureis, in illis virentibus supra purpureum), antheris introrsis et stigmatibus brevissimis praeclare distinguitur.

SCAPE erect, glabrous, (1.6-) 2.0-3.2 (-3.6) dm. long. BRACTS sessile, elliptic or elliptic-ovate to obovate—broadly or narrowly so, (6.0-) 6.5-9.5 (-13.0) cm. long, dark green, usually distinctly mottled with small darker spots, the apices rounded, obtuse or acute. SEPALS narrowly oblong-ovate, relatively short, (1.5-) 1.8-2.6 (-3.4) cm. long, basally spreading to horizontal, gently recurved near the middle and finally reflexed at the tips, usually dark purple adaxially or green, the apices slightly acuminate-blunt or obtuse (buds often slightly acuminate). PETALS linear-elliptic to linear-obovate, usually relatively short, (1.7-) 2.1-3.5 (-4.6) cm. long, erect, dark purple or rarely yellowish green, the apices acute or rounded. STAMENS erect, (8-) 11-17 (-19) mm. long; *filaments* (1.5-) 2-3 (-3.5) mm. long, nearly straight; *anthers* introrse on linear connectives, the connectives slightly prolonged beyond anther sacs to 0.5 (-1.0) mm. GYNOECIUM height usually reaching only slightly more than half the length of the stamens; *ovary* ovoid, (3.5-) 4-7 (-11) mm. in height, 3-angled in cross-section; *stigmas* subulate, usually very short, (1.5-) 2.0-4.5 (-6.5) mm. long, basally divergent, the tips recurved —forming with the ovary a lyre-shaped outline. FLOWERS with an odor like morel mushroom (*Morchella*). FRUIT ovoid, smooth; the stigmas withering, persistent at the apex.

HOLOTYPE: *Samejima 1039* with *Freeman* and *Channell* (GH). Abundant on a sandy bank slightly removed from small stream, 7.8 miles east of Milam on Texas Highway 21, Sabine County, Texas, 1 April 1966. Isotype at VDB; other duplicates to be distributed.

DISTRIBUTION: Open or fairly dense pine-hardwood forested slopes, stream banks and alluvium—usually rather sandy—in extreme southeastern Texas and adjacent southwestern Louisiana; locally abundant in the Upper

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[1] Excerpted from a dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of General Biology, Vanderbilt University, January 1969.

[2] Present address: Department of Botany and Plant Pathology, Auburn University, Auburn, Alabama 36830.

SIDA 3 (5): 289—292. 1969.

Coastal Plain along the Sabine River, extending into the Lower Coastal Plain near Lake Charles, Louisiana.

Peak of flowering in early April; fruits maturing about three months after anthesis.

a. *Trillium gracile* J. Freeman forma *gracile*

The petals, stamens, stigmas and usually the sepals purple; the ovary sometimes greenish.

b. *Trillium gracile* J. Freeman forma **luteum** f. nov.

A f. *gracili* petalis staminibus carpellisque luteis vel viridi-luteis differt.

Differing from the typical form by the yellow or greenish yellow color of the petals, stamens and carpels.

HOLOTYPE: *Samejima 1039a* with *Freeman* and *Channell* (GH). Occurring with the typical form at the type locality for the species (cited above).

TABLE I

COMPARISON OF MORPHOLOGICAL CHARACTERISTICS OF *T. viridescens*, *T. gracile* and *T. ludovicianum*.

Characters	*T. viridescens*	*T. gracile*	*T. ludovicianum*
Scapes	scabrous; (1.7-) 3.0-3.6 (-4.6) times bract length	glabrous; (2.4-) 3.2-3.5 (-4.3) times bract length	glabrous; (1.9-) 2.4-2.8 (-3.8) times bract length
Bracts	usually not mottled; sometimes with upper epidermal stomates near apex; apices acuminate to rarely acute	distinctly mottled; without upper epidermal stomates; apices rounded, obtuse or acute	distinctly mottled; without upper epidermal stomates; apices rounded to rounded-acute
Sepals	widely divergent or spreading; (3.5-) 3.8-5.4 (-6.3) cm. long; usually green adaxially	spreading-recurved; (1.5-) 1.8-2.6 (-3.4) cm. long; usually purple adaxially	widely spreading; (2.0-) 2.5-4.0 (-5.0) cm. long; usually green adaxially
Petals	linear-spatulate to very narrowly spatulate, distinctly clawed; the claws purple and blades greenish; (4.3-) 4.8-7.5 (-8.5) cm. long	linear-elliptic to linear-obovate, not clawed; usually purple throughout, rarely greenish; (1.7-) 2.0-3.5 (-4.5) cm. long	linear-obovate to linear, usually narrowly cuneate; the bases purple and blades greenish; (2.5-) 3.5-5.5 (-6.5) cm. long
Stamens	usually twice or more gynoecium height; anthers lateral; pollen yellow	slightly less than twice gynoecium height; anthers introrse; pollen creamy yellow	only one-third to one-fifth longer than gynoecium; anthers lateral; pollen olive to orange
Carpels	ovary sharply 6-angled; stigmas about as long as ovary, very widely spreading, tips recoiled	ovary 3-angled; stigmas about one-half as long as ovary, divergent, tips recurved	ovary sharply 6-angled; stigmas about as long as ovary, divergent, tips recoiled

As with the other species of sessile-flowered *Trillium*, a complex of characters is diagnostic for *T. gracile*. Its closest allies are *T. viridescens* Nutt. and *T. ludovicianum* Harbison, each of which has a range adjoining that of the new species. Plants of *T. gracile* have been treated as *T. ludovicianum* in the past, but a comparison of representative specimens of these morphogeographical taxa reveals several mutually delimiting characteristics which warrant their recognition as distinct species. The features distinguishing *T. viridescens*, *T. gracile* and *T. ludovicianum*, the first two of which occur only west of the Mississippi River, are compared in Table I.

The field characters distinguishing *Trillium gracile* from its nearby relatives are the smaller usually dark purple flowers, introrse anthers with creamy yellow pollen, three-angled ovaries and relatively short stigmas. This combination of features contributes to a slender and graceful appearance that is unusual among the species of sessile-flowered *Trillium*. Plants of the other species are usually robust, or even coarse in appearance, and the flowers relatively large. The epithet *gracile* alludes to the aspect of slenderness that results from the combination of slender scapes (usually more than three times the length of the bracts), usually narrowly elliptic bracts and relatively small flowers.

The occurrence of pure yellow-flowered forms in local populations of predominantly purple-flowered *Trillium* has been recorded in two species other than *T. gracile*. The flower color extreme recognized here as *T. gracile* f. *luteum* is believed to represent a genetic variant analogous to *T. sessile* f. *viridiflorum* Beyer and *T. recurvatum* f. *Shayi* Palmer and Steyerm. The only feature distinguishing these forms from their purple-flowered counterparts is the absence of anthocyanin pigments in all the inner floral parts. Such yellowish extremes of variation occur spontaneously in populations of typical plants, evidently throughout the respective ranges of the species.

To assure a fixed standard of comparison, the terminology for plane shapes recommended by the Systematics Association Committee of the International Association for Plant Taxonomy in Taxon *11*: 145-156 (1962) has been employed in the above description and discussion. Additional data on (and a detailed map of) the distribution of *Trillium gracile* in Texas, based upon the specimens cited here and more recent collections, are to be presented in a later jointly-authored paper. The writer wishes to acknowledge the curators of herbaria for the loan of specimens cited below and Dr. R. B. Channell, under whose direction this research was done.

DISTRIBUTIONAL CITATIONS

LOUISIANA. BIENVILLE PAR.: 4 mi. n. of dam, e. side of Lake Bistineau, 21 Apr. 1958, *McDaniel 13* (Louisiana Polytechnic Institute Herbarium). CALCASIEU PAR.: Vicinity of Calcasieu R., ca. 2.5 mi. n. of Lake Charles, 22 Mar. 1958, *Reese* and *Harris 1688* (FSU, GH, LAF, VDB); 1 mi. ne. of Moss Bluff, 17 June 1966, *Thieret 23562* (LAF). NATCHITOCHES PAR.: ca. 2 mi. s. of Bellwood, 7 Apr. 1966, *Thieret 22311* (LAF); Natchi-

toches, 17 Apr. 1915, *Palmer 7260* (CAS, K, NY, US); ca. 3 mi. s. of Provencal, 17 Apr. 1966, *Thieret 22312* and *22313* (LAF); Saline, 26 Mar. 1956, *Moore 6597* (GH, Louisiana Polytechnic Institute Herbarium). SABINE PAR.: 5.2 mi. w. of Hornbeck along La. 473, 18 Mar. 1965, *Kral 23384* (VDB); along Bayou LaNana, ca. 7 mi. sw. of Many, 7 Apr. 1966, *Thieret 22294* (LAF); ca. 3 mi. w. of Many, 7 Apr. 1966, *Thieret 22309* (LAF).

TEXAS. JASPER CO.: 5.5 mi. s. of Jasper, s. side of Zion Hill, 12 Apr. 1962, *Correll* and *Correll 24965* (LL); s. of Jasper off highway 96, between road to Magnolia Springs and road to Roganville, 14 Apr. 1963, *Correll* and *Correll 27226* (LL); ca. 7 mi. s. of Jasper, 20 Apr. 1964, *Correll 29404* with *Rosier* (LL); off U. S. Hwy. 190, se. of Jasper, 21 Mar. 1945, *Lundell 13367* (LL); 4.2 mi. s. of jct. of U. S. Hwy. 190 on Texas Farm Road 777, sw. of Jasper, 31 Mar. 1966, *Samejima 1037* with *Freeman* and *Channell* (VDB). JEFFERSON CO.? (probably cultivated): Beaumont, 1 Apr. 1936, *Hooks s.n.* (TEX). NEWTON CO.: 8 mi. e. of Burkeville, 11 June 1946, *Correll* and *Correll 12578* (LL, SMU); w. side of Burkeville along Little Cow Creek, 17 Mar. 1965, *Kral 23343* (VDB); ca. 7.5 mi. w. of Burkeville on Tex. Hwy. 63, 31 Mar. 1966, *Samejima 1036* with *Freeman* and *Channell* (VDB); 4 2/3 mi. s. of Newton, 4 Apr. 1947, *Cory 52601* (FSU, NY, TAES), 5 Apr. 1947, *Rowell, York* and *Tharp 47199* (GH, TEX); 2.8 mi. w. of Sabine R. bridge on Tex. Hwy. 63, 31 Mar. 1966, *Samejima 1035* with *Freeman* and *Channell* (VDB); just s. of Toledo, off road from Burkeville, 13 Apr. 1962, *Correll* and *Correll 24973* (LL). SABINE CO.: 12 ¾ mi. s. of Bronson, 20 Apr. 1950, *Cory 57266* (BUT, CAS, MIN, SMU); 3 mi. n. of Brookland, 6 Apr. 1947, *Rowell, York* and *Tharp 47215* (BUT, CAS, DAV, DUKE, GH, IA, ILL, IND, ISC, KANU, KSC, LCU, MIN, MO, NCU, NSC, NY, OKL, OKLA, OSC, PH, SMU, TEX, UARK, UC, UMO, US); 4.7 mi. w. Geneva, 18 Mar. 1965, *Kral 23370* (VDB); 7.5 mi. e. of Hemphill, 30 Mar. 1962, *Correll* and *Correll 24882* (LL); Milam, 27 Apr. 1963, *Demaree 47381* (VDB); 7.8 mi. w. of Milam on Tex. Hwy. 21, 1 Apr. 1966, *Samejima 1039* with *Freeman* and *Channell* (GH-type, VDB), *1039a* (GH-type of f. *luteum*). SAN AUGUSTINE CO.: 7 mi. e. of San Augustine, 17 Mar. 1962, *Correll* and *Correll 24832* (LL); 8 mi. ne. of San Augustine, 18 Mar. 1965, *Kral 23356* (VDB); San Augustine, 2 Apr. 1918, *Palmer 13251* (BKL, MO, US, WIS). SHELBY CO.: ca. 5 mi. e. of Aiken, 8 Apr. 1964, *Correll* and *Correll 29074* (LL); Sabine National Forest, East Hamilton Recreation Area along Sabine R., 6 Apr. 1966, *Correll* and *Correll 32417* (LL).

PARIETARIA HESPERA (URTICACEAE), A NEW SPECIES OF THE SOUTHWESTERN UNITED STATES

B. D. HINTON
Department of Biology,
University of Southwestern Louisiana, Lafayette[1]

This species has been known under several names: *P. debilis, P. floridana, P. debilis* var. *floridana*, and *P. pensylvanica* var. *floridana*. It is, however, sufficiently distinct from our other United States annual species to merit specific rank. For it, the following name is proposed.

PARIETARIA **hespera** Hinton, sp. nov.

Herba annua prostrata ad erecta, radicibus fibrosis. Folia petiolata; lamina late ovata, reniformis, vel orbiculata, palmatim 3-nervata vel interdum pinnatim nervata, basi truncata, rotundata, cordata, vel obtusa, apice rotundata, retusa, vel abrupte acuminata. Calyx 1.7-3.0 mm longus, lobi acuti ad anguste acuminati vel fere caudati, 0.4-0.7 mm lati, laxe conniventes vel patentibus ad interdum recurvata ad maturitatem. Achenia symmetrice apiculata, 0.75-1.4 mm longa, 0.5-0.85 mm lata, dilute brunnea ad brunnea, hilum interdum protrusum, margine non annulatim incrassatum.

Annual prostrate to erect herb with fibrous roots. Stem simple or sometimes branched at the base, finely or minutely pubescent to hirsute, subterete to terete, faces of the internodes smooth to slightly grooved. Leaf blades broadly ovate, reniform, or orbicular, 5-20 mm long, 4-17 mm wide, widest at about the middle, mostly palmately 3-veined but sometimes pinnately-veined, apex rounded, retuse, or very short acuminate, base truncate, rounded, cordate, or obtuse; upper surface smooth or with sparse fine or minute pubescense. Petiole 3-20 mm long. Involucral bracts conspicuous to nearly obsolete, linear to lanceolate, shorter than the calyx to sometimes longer, 1.0-4.0 mm long, 0.2-1.15 mm wide, pubescent, ciliate on the margins with long stiff hairs and short curled ones. Calyx tubular for one-third to one-half its length, yellowish-brown to dark reddish-brown at maturity, 1.7-3.0 mm long, lobes acute to narrowly acute or almost caudate, 0.4-0.7 mm wide, loosely connivent or spreading and sometimes recurved at maturity. Achene symmetrically apiculate, 0.75-1.4 mm long (usually 1.1 mm), 0.5-0.85 mm wide, light brown to brown, the hilum usually protruding from the body of the achene, not flanged.

HOLOTYPE (US): Arizona. Banks of Rillita. 10 April 1881, *C. G. Pringle*. ISOTYPE (MO). PARATYPE (UC): California. Shaded crevices of cliffs. San Bernardino Co. April 1886, *Samuel B. Parish*.

Range: Ariz., Calif., and S. Nevada.

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[1] Present address: 102 Forrest Avenue, Monroe, Louisiana.

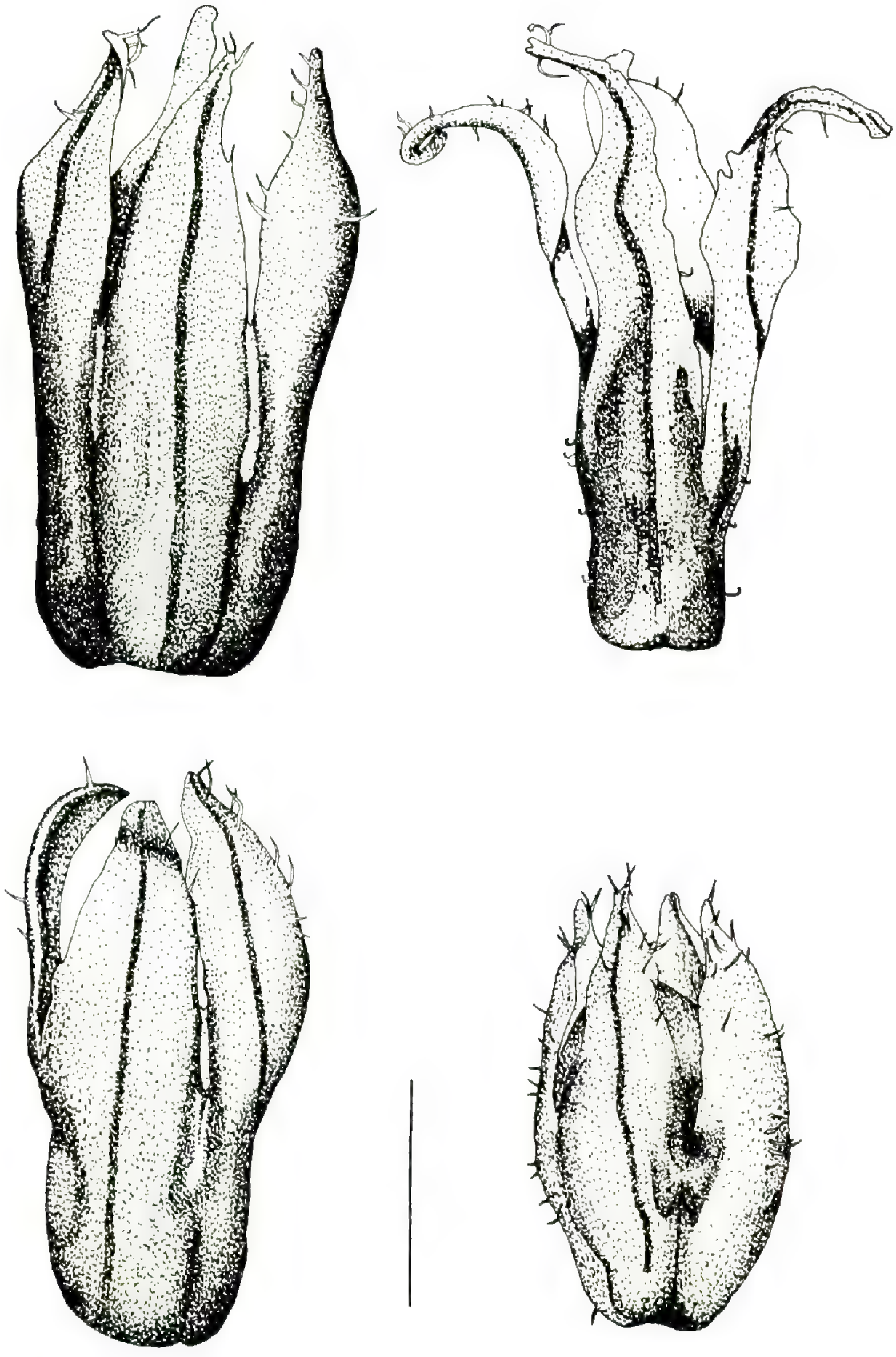

Fig. 1. Calyces in fruit: *P. hespera* var. *hespera* (upper left). *P. hespera* var. *californica* (upper right). *P. pensylvanica* (lower left and right). The line is equal to 1 mm.

Parietaria hespera is a highly polymorphic species. Two varieties may be distinguished, primarily by differences in the calyx, as follows.

Parietaria hespera var. *hespera*.

Lobes of calyx as long as the tube, acute to narrowly acute, loosely connivent, together at maturity, dark reddish-brown.

Range: Ariz., Calif., and S. Nevada.

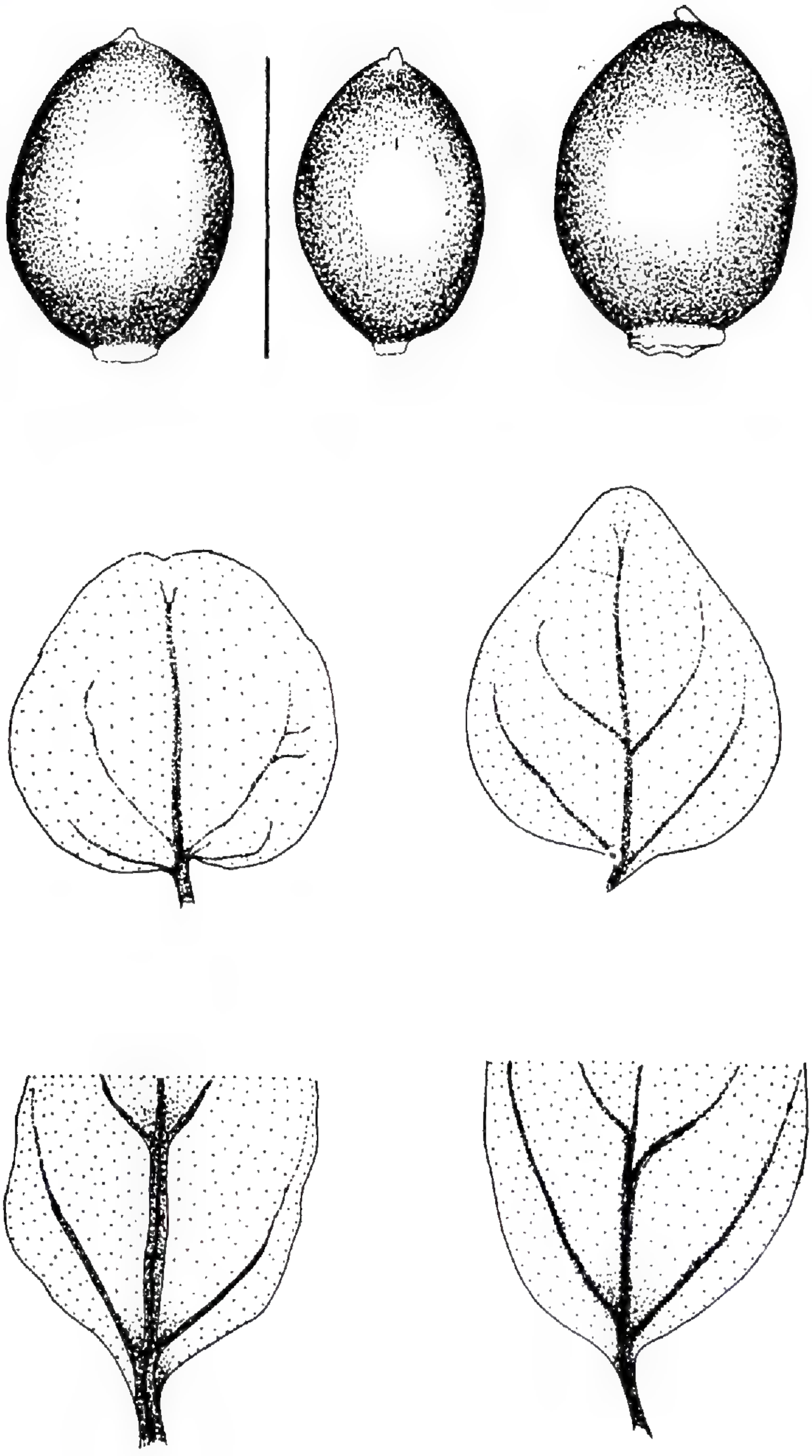

Fig. 2. *Parietaria hespera* var. *hespera*: achene (top left). *P. hespera* var. *californica*: achene (top center). *P. pensylvanica*: achene (top right). *P. hespera*: venation and leaf bases (middle left and right). *P. pensylvanica*: venation and leaf bases (lower left and right). The line is equal to 1 mm.

Parietaria hespera var. **californica** Hinton, var. nov.

A var. *hespera* recedit calycis lobis tubo duplo longioribus, anguste acutis ad fere caudatis, patentibus ad recurvatis.

Lobes of calyx twice as long as the tube, narrowly acute, to almost caudate, spreading and sometimes recurved at maturity, yellowish-brown to

light reddish-brown.

HOLOTYPE (UC): California. Oceano. Under bushes along swamp. Sand hills. 30 April 1910, *I. J. Condit.* PARATYPES, (MIN): California. Los Angeles, Griffith Park. 18 May 1925, *M. Epling*; (US): California, Riverside and vicinity, west side of Box Springs Mts. 29 March 1908, *Fred M. Reed 2297.*

Range: Southern California

Parietaria hespera, sympatric over a large part of its range with western *P. pensylvanica*, is generally readily recognizable therefrom by its leaves, calyx, and achene. In *P. hespera*, venation is typically palmate, i.e., the veins diverge immediately at the base of the blade (see fig. 2). In *P. pensylvanica*, venation is pinnate, i.e., the veins diverge slightly to definitely above the base of the blade (see fig. 2). The leaf base of *P. hespera* is typically round or truncate or sometimes cordate (see fig. 2). However, in a few thin- and membranous-leaved, highly succulent plants of var. *hespera* there may be some pinnately-veined leaves. These leaves are usually more broadly ovate and have more truncate bases than those of typical *P. pensylvanica.* If the plant is *P. hespera*, the pinnately-veined leaves will be found mixed with palmately-veined ones.

The calyx lobes of *P. hespera* are more narrowly acute and, in the membranous-leaved form, have somewhat curled apices while those of *P. pensylvanica* are more broadly acute and are usually not curled. The calyx averages somewhat larger, and the achene somewhat smaller, in *P. hespera* than in *P. pensylvanica.* As a result, the achene of *P. hespera* is more deeply set —more concealed—within the calyx tube (see fig. 1) than the achene of *P. pensylvanica*, in which the combination of smaller calyx and larger achene results in the achene being less deeply set—less concealed—than that of *P. hespera.* In *P. pensylvanica* the achene, indeed, may be well visible between the lobes of the calyx.

The following key is provided for the separation of our western annual *Parietaria.*

Calyx lobes erect to loosely connivent at maturity but not spreading, narrowly acute to acute

Leaves palmately veined or, in some membranous-leaved plants, pinnately veined in part (these plants can usually be distinguished by the light orange-brown calyx). Achene relatively deep set within the calyx (see fig. 1), ellipsoid, brownish. Calyx usually dark reddish-brown, its lobes narrowly acute, sometimes short-recurved at apex. Leaves ovate, broadly ovate, to orbicular, usually less than 1½ times longer than wide, their bases usually rounded or truncate. . . . . *P. hespera* var. *hespera.*

Leaves pinnately veined. Achene relatively shallowly set within the calyx (see fig. 1), ovoid, reddish-brown. Calyx dark reddish-brown, its lobes acute, not recurved at apex. Leaves linear-lanceolate, lanceolate, or sometimes ovate, usually 3 or more times longer than wide, their bases acute to obtuse, never truncate. . . . . *P. pensylvanica.*

Calyx lobes spreading to sometimes recurved at maturity, long attenuate, almost caudate. Leaves palmately-veined, reniform, broadly-ovate or orbicular, apex rounded or retuse, base cordate or rounded. Achene brown, ovate to broadly ovate. . . . . *P. hespera* var. *californica.*

I would like to thank Dr John W. Thieret for his assistance with the preparation of this paper and Dr. Thomas E. Wilson for his assistance with the photographs.

A TAXONOMIC STUDY OF SPIRAEA PYRAMIDATA GREENE (ROSACEAE)

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Spiraea pyramidata was described by Greene (1892) and sixteen years later Rydberg (1908) suggested that it was a hybrid between *S. menziesii* Hook. and *S. lucida* Greene. Other investigators have made the same suggestion based on characteristics which appear to be intermediate between the putative parents such as inflorescence shape, petal color, amount of pubescence, leaf shape, and plant size. This investigation was undertaken to see if tangible evidence might be accumulated to determine the origin and taxonomic status of *S. pyramidata*. The methods used were field study, analysis of morphological data based on mass collections, cytological study of microsporocytes, pollen viability tests, and experiments in hybridization of the suspected parents in the greenhouse.

The suspected parents are geographically sympatric but ecologically allopatric. *Spiraea menziesii*, considered by Presl (1851) to be a variety of *S. douglasii* Hook., and treated similarly here, ranges throughout the Cascades from Alaska to northern California, east to eastern British Columbia and central Idaho. This taxon usually occurs on the flood plains of streams, lake margins, drainage ditches, wet banks, and poorly drained fields. Mainly east of the Cascade crest, *S. lucida* extends from central British Columbia to north central Oregon, and eastward to South Dakota, Wyoming, and Saskatchewan. Normally, it is adapted to open or semi-open, dry and sometimes sandy areas with very little undercover growth. The putative hybrid ranges from central British Columbia southward, mostly east of the Cascade crest, to northeastern Oregon and central Idaho. It is almost always found on disturbed areas such as roadsides, highways, railways, forest camps, and homesites with either suspected parent or both.

MORPHOLOGICAL COMPARISONS. The three taxa are easily distinguished from one another based on reproductive characters. *Spiraea lucida* has a flat, corymbose inflorescence as long as wide, white petals, sepals erect, usually 20 stamens, and 10 staminodia. *Spiraea douglasii* var. *menziesii* has a paniculate inflorescence that is several times longer than wide, red petals, sepals reflexed, usually 30 stamens, and no stam-

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[1] Revised from a thesis submitted in partial fulfillment of the requirements for the degree of Master of Science at the University of Washington.

SIDA 3 (5): *298—308. 1969.*

Table 1. STATISTICAL COMPARISONS OF RATIOS OF CHARACTERS IN THREE TAXA OF *SPIRAEA*

Character		*S. douglasii menziesii*	*S. lucida*	*S. pyramidata* (Washington)	*S. pyramidata* (Canada)
leaf width/length	mean	38% (33)[2]	55% (41)	48% (53)	44% (64)
	st. dev.	±4.1%	±8.0%	±7.3%	±6.4%
	significance[3]	+	+	+	+
serration down/ leaf length	mean	32% (33)	53% (41)	52% (55)	31% (58)
	st. dev.	±14.0%	±13.0%	±9.9%	±17.7%
	significance	— to *S. pyr.* (Can.)	— to *S. pyr.* (Wash.)	— to *S. lucida*	— to *S. D.* var. *menziesii*
inflorescence width/length	mean	29% (33)	134% (41)	63% (53)	59% (64)
	st. dev.	±7.6%	±23.0%	±22.0%	±21.5%
	significance	+	+	— to *S. pyr.* (Can.)	— to *S. pyr.* (Wash.)
petal width/length	mean	72% (33)	80% (42)	76% (50)	74% (58)
	st. dev.	±14.0%	±12.0%	±12.8%	±17.8%
	significance	— to both *S. pyr.*	— to both *S. pyr.*	—to all	— to all
style length/ ovary length	mean	132% (32)	182% (40)	154% (50)	141% (48)
	st. dev.	±17.9%	±31.3%	±21.2%	±17.3%
	significance	+	+	+	+

[2] Numbers within parentheses are the total plants examined.
[3] + = A significant difference in the character is realized between the taxa 99% of the time.
— = No significant difference in the character is realized between the taxa 99% of the time.

inodia. The putative hybrid has a pyramidal paniculate inflorescence less than twice as long as wide, white to pink petals, sepals reflexed, 20-30 stamens, and 10-15 staminodia. Occasionally *S. pyramidata* resembles *S. douglasii* var. *menziesii* in inflorescence shape and flower color, but it always differs in having staminodia.

Vegetatively, the suspected parents are easily distinguishable whereas *S. pyramidata* is less so, particularly from *S. douglasii* var. *menziesii*. *Spiraea lucida* is ½-2 feet tall, glabrous on the stems and leaves, leaves that are commonly ovate-elliptic and coarsely (singly to doubly) serrate. *Spiraea douglasii* var. *menziesii* is 3-6 feet tall, pubescent on the stems and leaves, the leaves being oblong-elliptic and remotely (singly) serrate. The intermediate taxon is 2-4 feet tall, glabrous to slightly pubescent on the stems and leaves, and with ovate-lanceolate to obovate-elliptic leaves which are finely to coarsely serrate. In order to formulate a more objective basis for conclusions concerning the status of *S. pyramidata,* statistical information was accumulated. Ratios, of leaf width to leaf length, of distance that the serrations extend from the apex of a leaf as compared with total blade length, of inflorescence and petal width versus length, and of style length contrasted with ovary length, permitted one to use the same scale for comparisons. From these data, averages, standard deviations, and significance (Freund 1952) were determined for various populations and groups of populations and are presented in Table 1.

The statistical information is of more interest when plants of *S. pyramidata* from Washington and British Columbia were treated separately. The suspected parents were significantly different from one another in all five characters selected. They were also significantly different from *S. pyramidata* in leaf width over length and style length vs. ovary length but were not significantly different in petal width over length. In the serration character, *S. douglasii* var. *menziesii* was not significantly different from *S. pyramidata* from British Columbia nor was *S. lucida* significantly different from *S. pyramidata* from Washington. The suspected hybrids were significantly different from one another in leaf width over length, serration character, and style-ovary length ratio but not in inflorescence and petal shape. Mean comparisons of the 5 characters tend to show the Canadian populations of *S. pyramidata* to be more closely related to *S. douglasii* var. *menziesii*. These data in addition to field study indicate that introgression toward the latter taxon has occurred in the British Columbia populations.

Data based on Anderson's (1936) hybrid index were accumulated using 10 characters listed in Table 2. Values of 0 were assigned for each character if typical of *S. douglasii* var. *menziesii* and a maximum of 1, 2, 3, or 5 was assigned for a character if typical of *S. lucida*, the total for each plant resulting in a range from 0-21. Such characters as petal color and inflorescence shape were given the highest values because of their

distinct amount of variation. Most others, because of their less distinct variation were given a value from 0-2 and the least distinctive characters a value of 0 or 1.

After the plants had been identified, their ten characters were scored and their index determined. Graph 1 shows the index values for seven collections from 3 different areas in Washington. Found on the upper end of the index scale is *S. lucida* with *S. douglasii* var. *menziesii* on the lower end. Plants identified as *S. pyramidata* are in the center of the scale and slightly skewed toward *S. lucida*. The skewness may be explained by backcrossing and subsequent examination of the introgressants, or the F_1's in which the progeny resemble the pistillate parent somewhat more than the staminate one, or an error in judgment in assigning values to the characters. *Spiraea lucida* seemed more variable than *S. douglasii* var. *menziesii*, due perhaps to insufficient sampling or to contamination by genes from *S. douglasii* var. *menziesii* via a *S. pyramidata* bridge .

A British Columbian mass collection, composed mostly of *S. pyramidata*, is shown in graph 2. These index values which are throughout the scale may be contrasted with those of *S. lucida* and *S. douglasii* var. *menziesii* in graph 1. Two major peaks in frequency are evident, one somewhat similar to the peak formed by the mass collections of *S. pyramidata* from Washington, the second skewed toward *S. douglasii* var. *menziesii*. The second peak is probably evidence for introgressive hybridization of *S. pyramidata* with *S. douglasii* var. *menziesii*. A complete bridge between *S. lucida* and *S. douglasii* var. *menziesii* via *S. pyramidata* probably allows for genes to flow in the direction of either parent.

POLLINATORS. Visitors to *S. lucida* flowers are mainly beetles (*Mordella atrata* Melsh., *Pentaria trifasciata* Melsh., and *Orphilus niger* Rossi)[4] and occasionally bees (*Bombus* sp.). Flat topped inflorescences are particularly adapted for the landing of the "poor-flying" beetles according to van der Pijl (1960). The beetles randomly move about from flower to flower in the inflorescence, possibly feeding on the large, fleshy outgrowths just inside the rows of fertile stamens. These structures, believed to be staminodia, probably constitute an adaptive development. The beetles become covered with pollen shed from anthers they have touched, later contacting stigmas of various flowers of *S. lucida* and thereby effecting pollination. The occasional bee visitors spend little time on any one flower, but move from one inflorescence to another. Bees were the only observed visitors to *S. douglasii* var. *menziesii*. There was no discernible pattern to their flower visitation and they moved from flower to flower and inflorescence to inflorescence. Bees are probably responsible for intraspecific and interspecific hybridization

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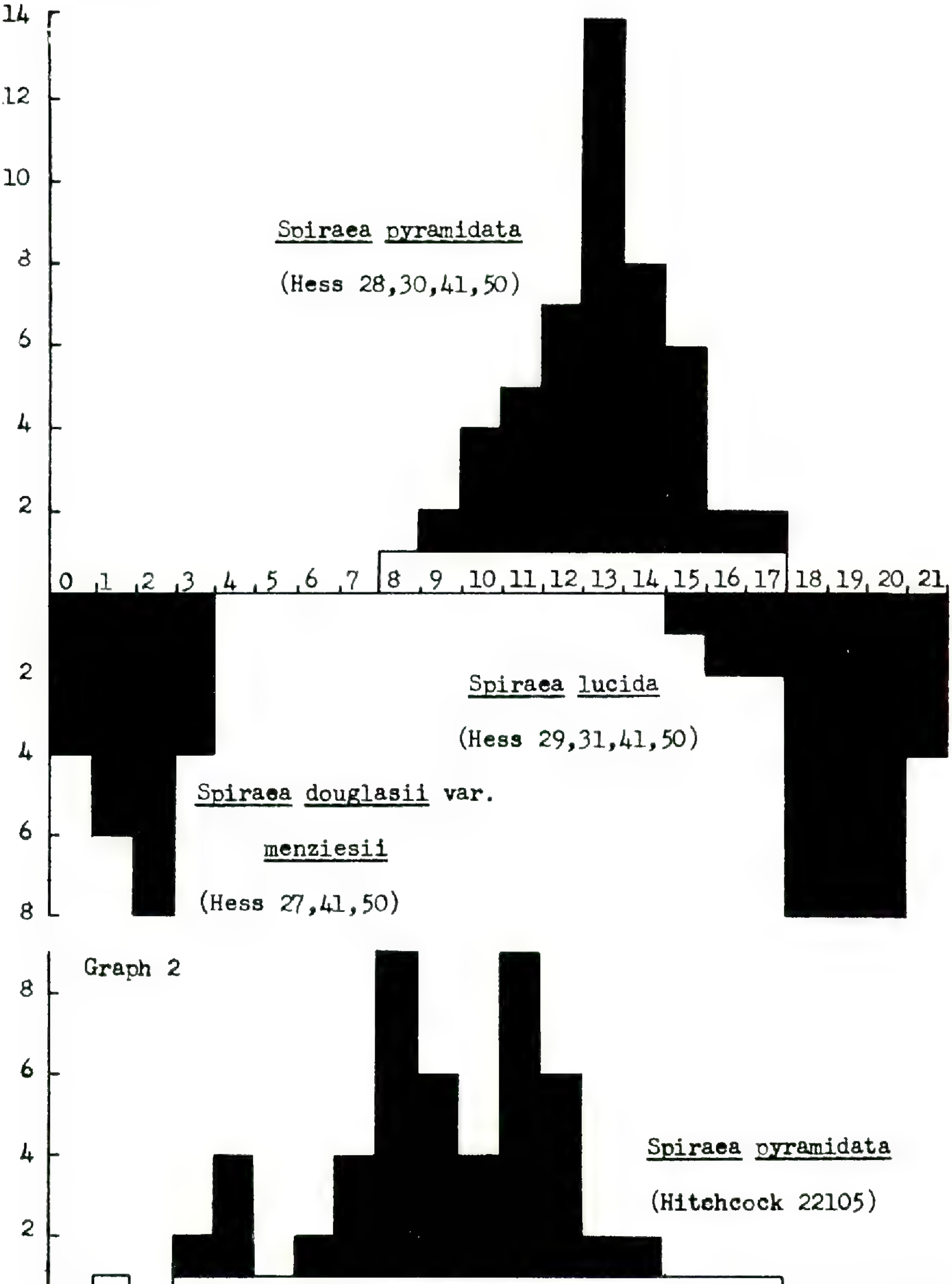
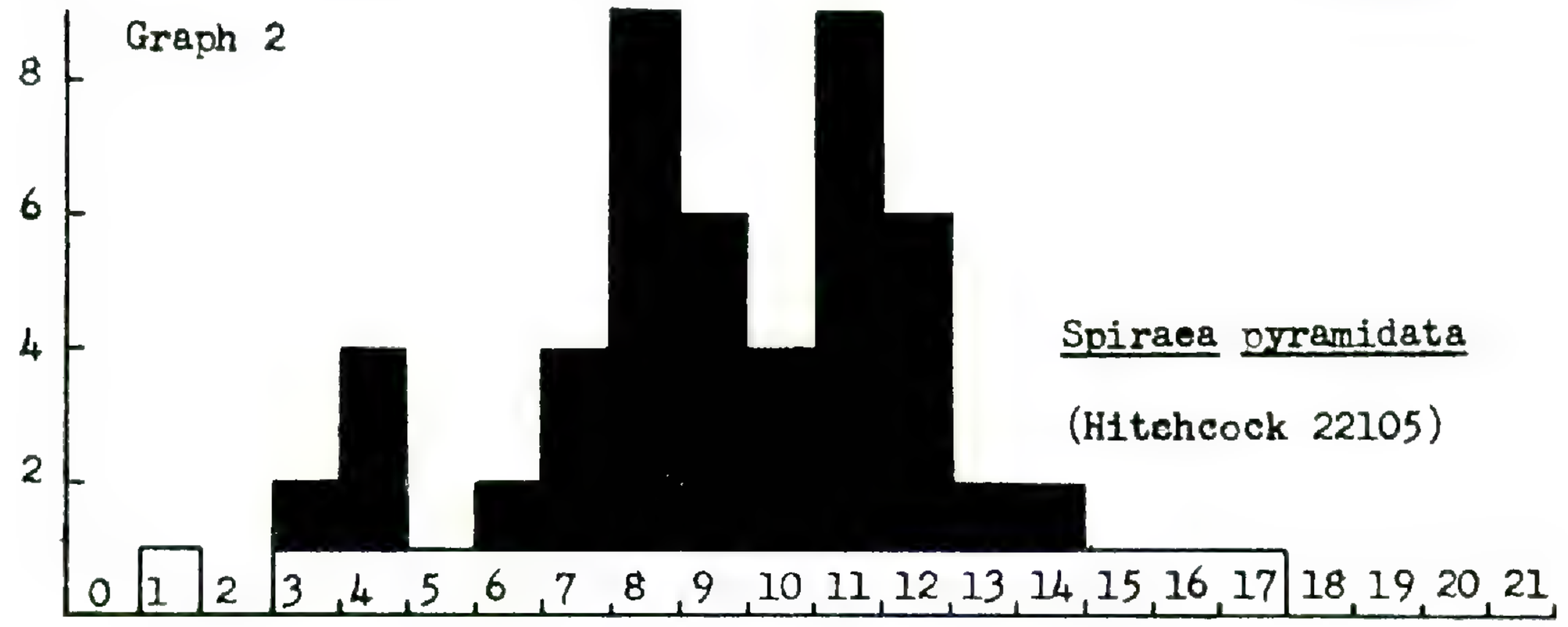
[4] Beetle identification was made by D. M. Hatch, Zoology Department, University of Washington.

Graph 1



Graph 2



since they are common to both suspected parents. Both bees and beetles visit the flowers of *S. pyramidata*. The staminodia probably account for the presence of the beetles and possibly a part of the same mechanism that attracts bees to *S. douglasii* var. *menziesii* accounts for their

Table 2. INDEX VALUES FOR TEN CHARACTERS

	S. douglasii var. *menziesii*	*S. lucida*
leaf shape	0	2
internode length	0	1
singly or doubly serrate	0	1
size of serrations	0	1
inflorescence shape	0	3
inflorescence vesture	0	2
petal shape	0	2
petal color	0	5
presence of staminodia	0	2
style to ovary ratio	0	2
	0	21

Table 3. POLLEN FERTILITY

Species	*Collection*	*% Pollen Fertility* Range	Average	*No. Plants Examined*
1. *S. douglasii* var. *menziesii*	*Hess 17.*	80-94	88	11
2. *S. lucida*	*Hess 44.*	71-89	84	5
3. *S. douglasii* var. *menziesii*	*Hitchcock 22059, 22103, 22105, 22113, 22114. Hess 23, 35, 37, 42, 48, 50.*			
4. *S. lucida*	*Hitchcock 22059, 22102, 22105, 22114. Beamish* et al *1470, 1484. Hess 24, 29, 31, 36, 37, 48, 50.*	39-90	64	25
5. *S. pyramidata*	*Hitchcock 22043, 22045, 22060, 22103, 22105, 22111, 22113. Beamish* et al *1470, 1488. Hess 9, 22, 28, 30, 34, 37, 48, 50.*	0-41	14	45

FIG. I.

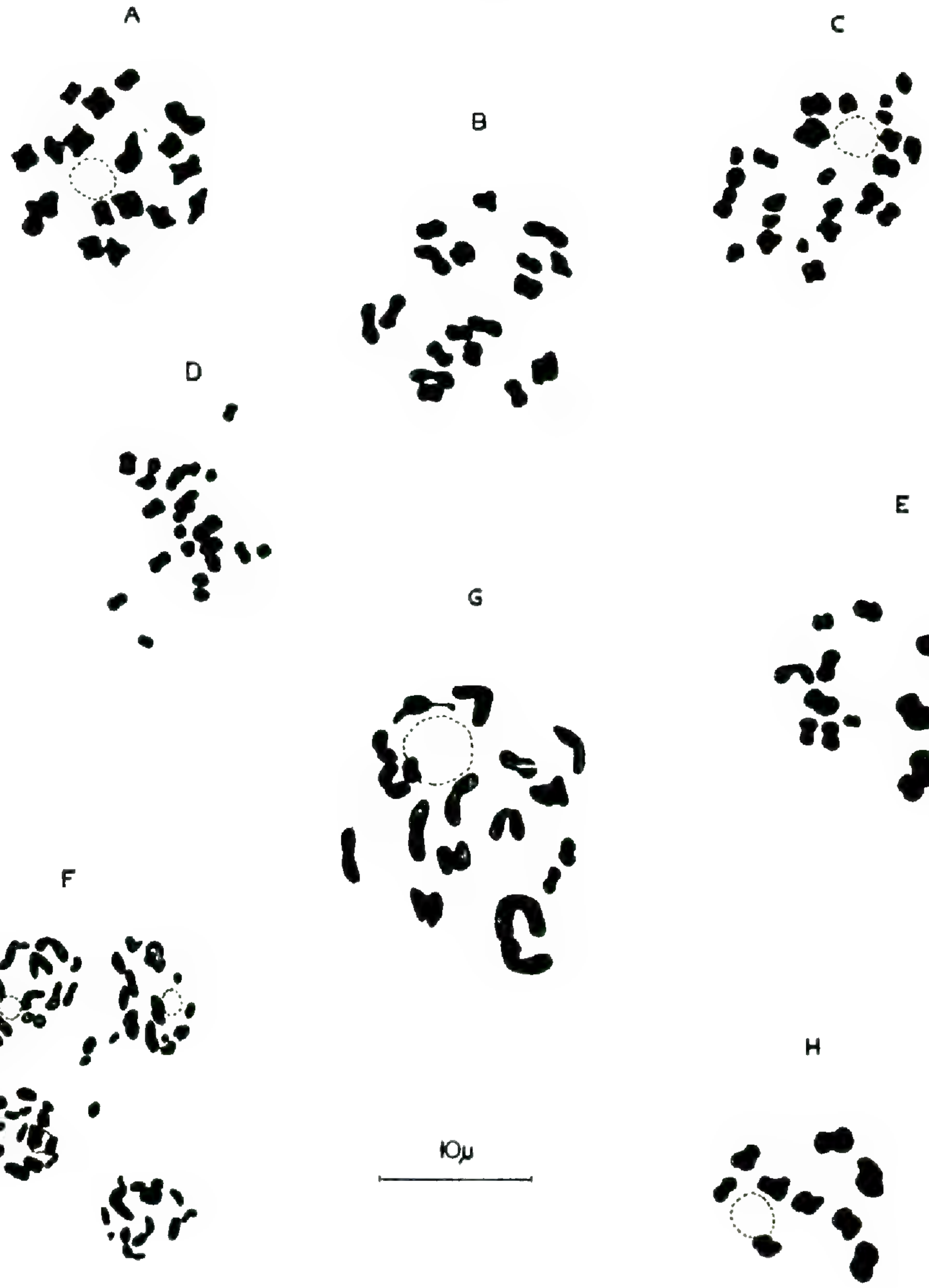


Fig. 1. Camera lucida drawings of chromosomes from microsporocytes of *Spiraea*. A. *Spiraea lucida, Kruckeberg 4964.* Diakinesis, 18_{II}. B. *Spiraea douglasii* var. *menziesii, Hess 50.* Metaphase I, 18_{II}. C. *Spiraea pyramidata, Hess 34.* Diakinesis, $10_{II}+16_{I}$. D. *Spiraea pyramidata, Beamish* et al *8807.* Metaphase I with precociously separated bivalents. E. *Spiraea pyramidata, Hess 37.* Diakinesis, 18_{II}. F. *Spiraea pyramidata, Hess 34.* Late telophase II with micronuclei indicated by the arrows. G. *Spiraea pyramidata, Hess 49A.* Diakinesis, 18_{II}. Greenhouse grown plants from seed collected in the field of *S. pyramidata (Hess 37).* H. *Spiraea densiflora, Hess 39.* Diakinesis, 9_{II}.

presence. Outbreeding as well as inbreeding (both geitonogamous and autogamous) among the three taxa occurs due to the two pollinators.

POLLEN STAINABILITY. Stamens were removed from dried flowers and squashed in cotton blue-lactophenol and the number of pollen grains that stained well were counted. The staining is interpreted as evidence for fertile pollen grains.

Pollen fertility of the various taxa is listed in Table 3. The first two collections, which represented pure and well isolated populations, showed a high pollen fertility. Each of the next 3 groupings of collection numbers represented mixed mass collections. The fertility range of *S. douglasii* var. *menziesii* and *S. lucida* in these mixed populations was considerably greater than in the pure populations. The fertility of *S. pyramidata* was also variable. An explanation of the wide stainability range may be that backcrossing of the putative hybrid with the suspected parents has produced plants (introgressants) similar in morphology to the three taxa but cytologically variable.

CYTOLOGY. The cytological information was obtained from bud material collected in the field, from greenhouse grown plants at the University of Washington, and from material sent from the University of British Columbia through the kindness of Dr. K. Beamish. Those buds personally collected were fixed in vials containing freshly prepared 3 parts 95% ethanol and 1 part glacial acetic acid, and stored in a refrigerator no later than 10 days after collection.

Counts were made of each taxon from at least four different areas. Buds that showed the best meiotic figures were from 1-2 mm. in length. Temporary mounts were made of anthers squashed in aceto-carmine stain. Microsporocytes that showed the desired meiotic figures were drawn with the aid of a camera lucida apparatus. After cytological examination the temporary mounts were made permanent by the alcohol exchange-euperal method of Bradley (1948).

The basic chromosome number for *Spiraea* is 9 (Darlington and Wylie, 1955). Four counts of New World species by Sax (1936) indicate three of them tetraploids and the other a triploid. Bowdin (1945) reported another New World species to be a tetraploid. Table 4 lists the chromosome numbers of the three pertinent taxa involved in this investigation plus *S. densiflora* Nutt. ex T. and G. because of its general interest. Figure 1 shows camera lucida drawings of the four taxa. Eighteen bivalents were consistently noted in the microsporocytes of *S. lucida* and *S. douglasii* var. *menziesii*. The somatic chromosome number of *S. pyramidata* totaled 36, consisting of either 18 bivalents or mostly of combinations of bivalents and univalents. The anthers of some flowers had microsporocytes with both 18 bivalents and combinations of bivalents and univalents. The presence of precocious separations and micronuclei in the pollen tetrads was also evidenced (Fig. 1). This would account for low pollen fertility in the hybrid.

Table 4. SOMATIC CHROMOSOME NUMBER

Species	*2n*	*Source of Preserved Material*
S. douglasii var. *menziesii*	36	Washington: Chelan Co., *Hess 10, 11, 12, 42;* Whatcom Co., *Hess 50.* British Columbia: Yale District, *Hitchcock 22061;* Wells District, *Beamish* et al *8809.*
S. lucida	36	Washington: Okanogan Co., *Hess 44;* Whatcom Co., *Hess 50;* Kittitas Co., *Kruckeberg 4964.* British Columbia: Wells District, *Beamish* et al *8808.*
S. pyramidata	36	Washington: Kittitas Co., *Hess 37;* Plants grown from seed of *Hess 37, 49.* British Columbia: Yale District, *Hitchcock 22060, 22045;* Wells District, *Beamish* et al *8807, 8810.*
S. pyramidata	36 $9_{II}+18_{I}$	Washington: Chelan Co., *Hess 9, 30.*
S. pyramidata	36 $10_{II}+16_{I}$	Washington: Yakima Co., *Hess 34.* British Columbia: Wells District, *Beamish* et al *8810.*
S. pyramidata	36 $11_{II}+14_{I}$	British Columbia: Wells District, *Beamish* et al *8799.*
S. pyramidata	36 $13_{II}+10_{I}$	Washington: Chelan Co., *Hess 28.*
S. pyramidata	36 $14_{II}+8_{I}$	British Columbia: Wells District, *Beamish* et al *8807.*
S. densiflora	18	Washington: Pierce Co., *Hess 39.*

It was of interest to note that *S. densiflora* was a diploid with 18 chromosomes. This is the first report of a diploid *Spiraea* in the New World, although Sax (op. cit.) reports 11 diploids of the genus in the Old World. The suspected hybrid between *S. douglasii* var. *menziesii* and *S.densiflora* is of particular interest for further study. It is possibly a triploid yet is similar morphologically to some suspected introgressants of *S. pyramidata* which are tetraploids. Future investigations will include this aspect of research.

GREENHOUSE STUDY. In the summers of 1960 and 1961 seeds, cuttings, and live plants of the three taxa were collected in the field. Attempts were made to grow them in the greenhouse, the ultimate object being to duplicate the natural hybrid by artificial means, if possible. The suspected hybrid and *S. douglasii* var. *menziesii* grew well from

cuttings, field transplants, and seeds. Field transplants and progeny from the seeds of *S. lucida* grew well but only 3 of 70 cuttings survived. Plants that developed from seed reached flowering stage after 6-8 months of development.

The seeds from *S. pyramidata,* which were collected in the field, developed into plants that resembled *S. lucida* in size and inflorescence shape. Some had normal appearing flowers but a few had leafy calyx lobes and petals, few stamens, and only 2 or 3 carpels. The latter condition is not considered to be uncommon in greenhouse grown plants.

In the summer of 1961 artificial reciprocal crossings involving *S. lucida*; the plants grown therefrfom in the greenhouse appeared to be tendency of greenhouse grown plants of the latter species to wilt only one set of crosses was made. Emasculation performed on the flowers just before anthesis was difficult since the flowers were small and stamens numerous. Hand pollination was effected periodically over three days. The carpels of *S. douglasii* var. *menziesii* apparently do not mature until spring and early summer so no seeds at the time of the study had been acquired. On the other hand, seeds had been produced on *S. lucida;* the plants grown therefrom in the greenhouse appeared to be vegetatively intermediate to the parents or similar to *S. pyramidata.* Observations of the developing inflorescence corroborated the intermediate nature of the hybrid; however, the author had to leave before full development was realized. Further verification was not obtained.

SUMMARY. The hybrid-origin hypothesis has been substantiated by evidence derived from field study of the pollinators and the hybrid environments, cytological investigations that have disclosed univalent and bivalent chromosomes, precocious separations of chromosomes in pollen mother cells, and micronuclei in spore tetrads, tests of pollen viability, morphological examinations, statistical studies such as hybrid indices, and controlled artificial hybridization.

Spiraea douglasii var. *menziesii* and *S. lucida* were successfully crossed in the greenhouse. The viable seeds produced grew into two dissimilar sets of plants, one of which consisted of seedlings that apparently would not survive in natural surroundings, the other of larger and more vigorous plants that would have a much greater chance for survival in natural conditions. The vegetative characteristics of the more robust plants were similar to those of *S. pyramidata.* There is no reason to doubt that hybridization is occuring constantly between the suspected parents and only if the seed falls in a disturbed habitat will there be any selective advantage. Once the hybrid is established, it spreads extensively by rhizomes but only in the open and disturbed areas.

There is little indication for introgression in Washington, since *S. pyramidata* was collected in 1892 around "Clealum", and currently it seems to show no introgression in that area. It probably became estab-

lished during some habitat disturbance where it persisted and spread vegetatively. In contrast, introgression seems not uncommon in British Columbia. No explanation is available as to why introgression was evident in British Columbia and not in Washington. On route 90, 7 miles north of Quesnel, British Columbia, a large mixed population of *S. pyramidata, S. douglasii* var. *menziesii,* occasional *S. lucida,* and apparently introgressants extends for several miles. After the hybrid had been established, possibly a second disturbance created another "hybridized habitat" and seedlings of introgressants were then able to become established. As long as the introgressants are recognizable as the hybrid, it seems reasonable to include them as part of *S. pyramidata.*

Spiraea pyramidata, a tetraploid, is the result of an interspecific cross between two tetraploids and is strikingly different morphologically, physiologically, genetically, and ecologically from either parent. Although widespread, it occurs only in areas where the parents have come together in a disturbed habitat. There is little morphological variation between individuals of the same population and only slightly more variation between different populations. The plants are perennials that spread by a strong rhizome system. The phenotypic pattern is apparently similar from population to population and because of some sterility factors few intergradient populations are formed through back-crossing. It is proposed that the taxon be accorded status as *S. × pyramidata (S. douglasii × S. lucida)* Greene, a term that portrays its origin.

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CELASTRUS (CELASTRACEAE) IN THE SOUTHEASTERN STATES

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The occurrence of *Celastrus scandens* L. in all but two of the Southeastern States, Louisiana and Florida, has been documented by herbarium specimens. Its distribution has been mapped by Duncan (1967). This is the only *Celastrus* native to the area. However, an Asiatic species, *C. orbiculatus* Thunb., which has become naturalized locally, should also be added to the naturally occurring species of the Southeastern States.

When "Woody Vines of the Southeastern States" (Duncan, 1967) was published, I had not seen a specimen documenting *C. orbiculatus* as being naturalized other than presumably immediately around homes. Since then, I have observed an extensive naturalized colony on both sides of the Appalachian Trail at Neal's Gap, Union and Lumpkin Counties in the Blue Ridge Province, Georgia. Plants occur in a deciduous woods between approximately 3050 and 3200 feet elevation. The species, therefore, does belong to the natural flora of Georgia and should be included with the woody vines of the Southeastern States.

The *Celastrus* at Neal's Gap apparently has become naturalized from individuals planted along a formal walkway behind the inn. I saw plants there a good many years ago, probably in the fall, 1940, but did not see any escapes of it. At that time I believed the plants were *C. scandens*. In September 1967, I observed the extensive colony in the woods at Neal's Gap and realized that the plants were not *C. scandens*. A specimen was sent to Dr. Carroll Wood at the Arnold Arboretum of Harvard University for checking since we lacked comparative material in our herbarium. Dr. Wood pointed out that the *Celastrus* was *C. orbiculatus*.

Plants are so abundant in places at Neal's Gap that some native plants have been eliminated. The twining stems have also damaged a few young plants of tree species. Now that *C. orbiculatus* is known to be so abundantly naturalized, it seems that other records for the species in the Southeast should be reviewed as possible naturalized colonies outside the immediate influence of man. Brizicky (1964) reports that the species is naturalized in Virginia and Tennessee (Great Smoky Mountains National Park). Radford, et al. (1965) indicate that it occurs in North Carolina in two counties, New Hanover and Henderson. The species is omitted from their 1964 "Guide."

Celastrous orbiculatus differs from *C. scandens* in having few-flowered axillary inflorescences along short stems of the current year instead of terminal inflorescences on generally longer stems of the current year. In the former, leaves are present among at least the lower flowers and fruits until late in the growing season, but are lacking among the flowers or fruits in the latter species. Leaf blades of *C. orbiculatus* are oblong to obovate or

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suborbicular with length-width ratio generally between 1.2 and 1.7, whereas in *C. scandens* they are ovate to ovate-lanceolate or elliptical with the length-width ratio generally being from 1.8 to 2.6.

Voucher specimens of the Georgia collection of *C. orbiculatus* are on deposit in the herbaria of the University of Georgia and the Arnold Arboretum of Harvard University.

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KEY TO VIOLETS (VIOLA, VIOLACEAE) OF NACOGDOCHES COUNTY, TEXAS

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This key is of service in a very small geographical area. Most Nacogdoches violets are in the group known as the stemless blues, which is poorly understood and overdefined. *Viola* students will notice some changes of emphasis on morphological characters, differences in data from those of other workers and more use of the style for delimiting taxa. Although the local stemless blues are presented in this key as species, the author's data lead her to see them as the most successful phenotypes among the many emerging from the local gene-pool.

KEY TO NACOGDOCHES COUNTY, TEXAS, VIOLETS (VIOLA-VIOLACEAE).

1. Plants with aerial stems.
   2. Stems soon prostrate . . . . . *V. Walteri* House
   2. Stems erect.
      3. Petals yellow . . . . . *V. pensylvanica* Michx.
      3. Petals not yellow.
         4. Leaves small with obtuse tips, petals violet . . . . . *V. rafinesquii* Greene
         4. Leaves larger with acute tips, petals tricolored, cultivated. . . . . *V. tricolor* L.
1. Plants without aerial stems.
   5. Petioles and peduncles arising from stolons.
      6. Leaves ovate. . . . . *V. primulifolia* L.
      6. Leaves lanceolate. . . . . *V. lanceolata L. subsp. vittata* (Greene) Russell
   5. Petioles and peduncles arising from rhizomes.
      7. Style uncinate.
         8. Rhizomes and stolons present; cultivated. . . . . *V. odorata* L.
         8. Rhizomes only present; cultivated. . . . . *V. odorata* L. × *V. hirta* L. × ?
      7. Style clavate.
         9. Style thick-clavate with stigmatic aperture on side toward summit; flowers all chasmogamous, none cleistogamous. . . . . *V. pedata* L.
         9. Style clavate, laterally beaked; flowers chasmogamous and cleistogamous in spring, cleistogamous only in summer.
            10. Leaves crenate, dentate or serrate, not deeply lobed or divided.
               11. Plants glabrous.

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12. Spur petal glabrous. . . . . *V. Langloisii* Greene
12. Spur petal bearded.
13. Petals pied, purplish or reddish . . . . *V. affinis* LeConte
13. Petals white, all or in part. . . . . *V. affinis* LeConte forma *albiflora* Henry

11. Plants pubescent.
14. Leaves orbicular to ovate, veins reddish, spur of lower petal large, cream-colored. . . *V. villosa* Walter
14. Leaves cordate-ovate, veins not reddish, spur of lower petal not large, cream-colored.
15. Stigmatic aperture small, at end of beak; petals blue to purple. . . . . *V. sororia* Willd. var. *sororia*
15. Stigmatic aperture large, long on top of beak; petals white; cultivated. . . . *V. sororia* Willd. var. *incognita* Lacey

10. Leaves lobed or divided.
16. Plants glabrous.
17. Leaves lobed sagittately. . . . . *V. sagittata* Ait.
17. Leaves lobed otherwise.
18. Plants confined to Angelina and Attoyac River banks. . . . . *V. Langloisii* Greene
18. Plants of drier, disturbed habitats. . . . . *V. Lovelliana* Brainerd
16. Plants pubescent.
19. Leaves 2-3 cleft. . . . . *V. Lovelliana* Brainerd
19. Leaves divided nearly to base into 5-7 segments. . . . . *V. triloba* Schwein. var. *dilatata* (Ell.) Brainerd

VIOLA SORORIA var. **incognita** Lacey, var. nov. Culta (originis ignotae), etiam fera. Apertura stigmatis magna supra rostrum elongata. Petala alba. HOLOTYPE. TEXAS, Nacogdoches Co.: yard of Miss Lum Shipe, Raguet St., Nacogdoches. A cultivated violet that has naturalized. White petals. Breeds true over a long period of years. Cleistogenes purple spotted. *Janice B. Lacey 30*, 24 March 1955. PARATYPES. Cleistogamous plant coll. 12 April 1955 (mounted on same sheet with preceding). Same locality, *Lacey 30A*, 7 July 1955. (All specimens at SMU.)

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BACOPA EGENSIS (POEPPIG) PENNELL (SCROPHULARIACEAE) IN THE UNITED STATES

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INTRODUCTION

The genus *Hydranthelium* (Scrophulariaceae) was described by Humboldt, Bonpland, and Kunth in 1825 based upon the species *H. callitrichoides*. Since then, additional species have been described and the genus has been redefined as a subsection of the genus *Bacopa*.

The genus is normally considered to be neotropical; however, *B. egensis* (Poeppig) Pennell has been reported from Africa (Bentham and Hooker, 1862) and a specimen is available from the Belgian Congo (MO no. 1639137). *Bacopa egensis* has been reported also from the United States (Wood, 1870 and 1889; Mann, 1872; Chapman, 1878, 1889; Gray, 1888; and Small, 1903) based upon collections of Josiah Hale in the early 1800's. In light of a recent rediscovery of this species in Louisiana, of the paucity of extant specimens in U.S. herbaria, and of confusion which exists in the literature concerning this species in the United States, this review was prepared.

DESCRIPTION

Bacopa egensis grows in shallow water along the edges of quiet bodies of water (sometimes on shore slightly above water). Its stems are lax, aerenchymous, borne radiating from a common root system (but frequently rooting at the nodes when buried), and up to 3 dm or so in length. The leaves are mainly floating, opposite, borne in a rosette-like fashion at each stem apex (as the stem matures, elongation of the internodes leaves behind one pair of opposite leaves at each node but these normally soon begin to disintegrate); mature leaves broadly spatulate, crenate distally (the first pair of leaves produced by a new stem apex are more-or-less oblong and entire but later pairs appear progressively more similar to the mature form); main veins 5-6 (-9), parallel through the petiole but diverging in the blade; petiole flat with aerenchyma between the main veins (but not inflated), petiole bases clasping the stem (those of a pair appearing as slightly joined to either side of the stem); leaves estipulate, valvate in bud. Flowers ebractate, actinomorphic, borne 1-2 per leaf axil, pedicellate (mature pedicels up to 11-12 mm in length). Sepals 4, greenish, connate about ½ their length into calyx tube, length (from base of tube to apex of lobe)

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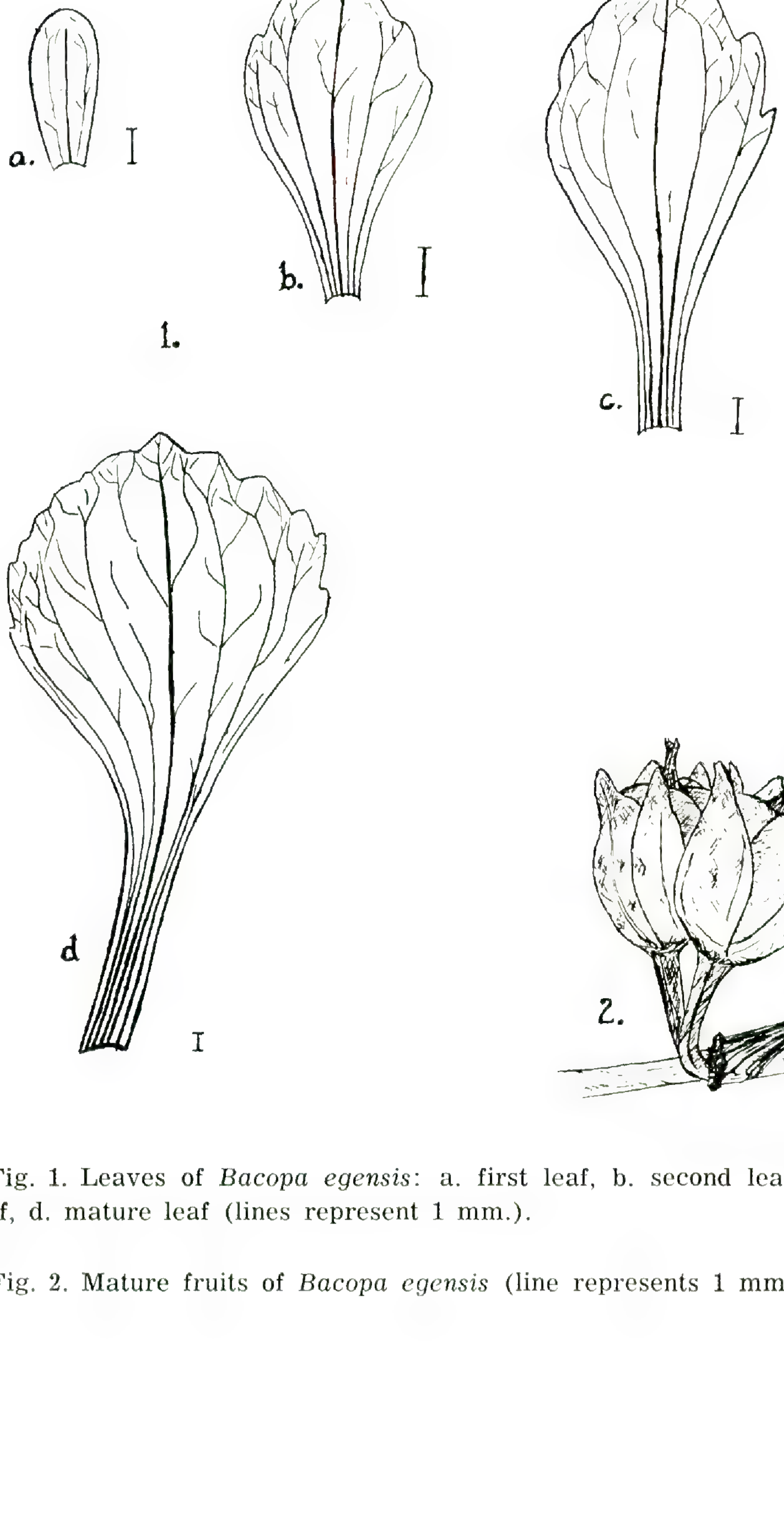

Fig. 1. Leaves of *Bacopa egensis*: a. first leaf, b. second leaf, c. third leaf, d. mature leaf (lines represent 1 mm.).

Fig. 2. Mature fruits of *Bacopa egensis* (line represents 1 mm.).

Fig. 3. Specimens of *Bacopa egensis*.

2½-3 mm, lobes reflexed in mature flower, acute; calyx persistent and enclosing maturing fruit. Petals 3, white with bluish streaks, connate for about ½ their length into corolla tube, length (from base of tube to apex of lobe) 3½-4½ mm, lobes apically cupped and imbricate in bud (enclosing androecium and gynoecium) but spreading (to reflexed) in mature flower, rounded at apex; corolla deciduous at maturity. Stamens 3; anthers dorsifixed, blue to violet in color, bilobed with lobes distinct (except where united with filament) (in one specimen, one of the 3 filaments bore 2 bilobed anthers—the inner lobe of each being aberrant at its base in the area of attachment to the filament); stamens alternate with corolla lobes, epipetalous with filaments inserted in sinuses of corolla lobes, total length of stamen slightly less than corolla lobes. Style 1, bifurcate at apex; stigmas 2, about equal with midpoint of anthers in mature flowers. Ovary bilocular, superior, placentation axile, ovules numerous, orthotropous; seeds minute, striated, elongate (shaped like a small banana); fruit globular, topped by persistent style and surrounded by persistent sepals (which exceed it in length giving the appearance of 4 small "horns").

TAXONOMY

Pennell, in his 1935 monograph of the Scrophulariaceae, discussed the basic similarities to be found among several of the then recognized aquatic genera of the family (e.g., *Herpestis* or *Monniera, Hydranthelium,* and *Macuillamia*) and states these, " . . . form an association of nearly related genera that tend to vary in the same structures. . . ." Of these genera he states, "Weakest of all may well be *Macuillamia,* likely to be reduced at least to *Hydranthelium.*" Although retaining the genera as distinct in the main text, on pp. 629 and 630 (of "Additions and Corrections") he further discussed the relationship and concluded that the members of the genus *Hydranthelium* HBK," . . . are to be considered merely as florally reduced members of a common genus . . . ," which would include from the United States, the species *Monniera rotundifolia* Mich., *Macuillamia obovata* Raf., *Gratiola repens* Sw., and *Hydranthelium egense* Poeppig, and which, because of priority, should bear the name *Hydranthelium.* In 1946, Pennell further discussed this concept and concluded that his 1935 genus *Hydranthelium,* as well as other genera, exhibited evolutionary reduction in a clinal manner and, therefore, should be grouped together. To this end, he redefined the genus *Bacopa* and established *Hydranthelium* as a subsection within the section *Herpestis;* including within this subsection taxa previously belonging to such genera as *Hydranthelium, Herpestis, Macuillamia,* and *Bacopa.* This treatment has been followed, at least in part, by more recent workers (e.g., Barroso, 1952; Fernald, 1950; and Gleason and Cronquist, 1963). Included in synonomy with *Hydranthelium* should be *Hydrathelium,* an apparent typographical error by Pennell, 1921, page 464.

The name *Hydranthelium egense* Poeppig and Endlicher, as well as *H. egense* Poeppig, should be placed in synonomy under *Bacopa egensis* (Poeppig) Pennell. Bentham and Hooker (1862) credited the name *H. egense,* to Poeppig and Endlicher as did Small (1903) while Pennell (1921, 1936, 1946) and Gray (1888) cited Poeppig as the only author. Chapman (1878) and Mann (1872) also list Poeppig as the author but followed by a question mark (although the latter may have been placed to question the presence of the species and not the author). This confusion evidently arose from the method of publication of the original name. *Nova genera ac species plantarum* was published in three volumes, the first two by Poeppig and Endlicher and the third by Poeppig alone. Since *H. egense* was described in the third volume, the author's name should be, as later authors have indicated, only Poeppig.

When Wood first listed the species from the United States (1870), he did so under the name of *H. crenatum,* following a description of the genus accredited properly to Humbolt, Bonpland, and Kunth. The description he gives of *H. crenatum* matches that of *H. egense* Poeppig and he cites specimens of Hale which were labelled *H. egense.* Wood makes no explanation of his name *H. crenatum* and no other reference to the name is in the literature. *H. crenatum* Wood, therefore, should be placed in synonomy under *Bacopa egensis.*

UNITED STATES RECORDS

Bacopa egensis was first collected in the United States by Dr. Josiah Hale in the early 1800's. The first mention in the literature was by Wood (1870) who gives the data, "Pools, Miss., La. (Dr. Hale)." Chapman (1878, 1889) again cites Hale's specimens but gives the location as New Orleans as does Gray (1888) who states, " . . . picked up in New Orleans by the late J. Hale. . . ." Small (1903) gives the location as, "In swamps, near New Orleans, Louisiana," and adds, "Not collected recently." Pennell (1921, 1935) again cites Hale's specimens but credits these to, "Louisiana. Rapides Parish: Alexandria."

In order to verify the location of Hale's collecting site (or sites), I attempted to obtain his specimens. Pennell (1935) cited these from NY and GH, and since Pennell worked with the Philadelphia Academy of Sciences, these three herbaria were contacted. In addition, inquiries were made of YU, US, NO, MO, and LSU. The only specimens of Hale's which apparently are extant are four at NY. According to N. H. Holmgrem of the herbarium (1966, personal communications), the labels of two of these read, "Dr. Hale, Louisiana," the third merely has "Louisiana," and the fourth reads, "Dr. Hale, Alexandria." No other information, including dates, is present.

To help clarify the question as to Hale's collecting sites, Dr. Joseph Ewan kindly furnished me a biographic sketch of Hale, from the New Orleans Academy of Sciences minute book of 1854 to 1857. From 1822 to 1824, Dr. Hale lived in Port Gibson, Mississippi; in 1824 and 1825, he spent time travelling, " . . . mostly in Louisiana and studying the wild vegetable productions of the South . . . "; from 1825 to 1828, he lived on a plantation 20 miles from Alexandria, La.; from 1828 to 1850, he lived in Alexandria; from 1850 to 1855, he lived in New Orleans; and in 1855 he moved to Canton, Miss., where he lived until his death in July 1856. Not only did Hale's places of residence allow for his collecting in all of the places to which his collections have been credited but, also, from 1834 to 1850 he lived in retirement and, " . . . wholly devoted himself to the study of plants and other objects of Natural History." The only key to this is his NY specimen labelled "Alexandria" but this does not preclude his having collected other specimens in other locations.

The second apparent collection of the species in the United States was by Dr. Neil Hotchkiss. He has informed me (1966, personal communication) that in October 1933, he found a plant, in Catahoula Lake, LaSalle Parish, La., which he tentatively identified as *H. egense*. The specimen, however, is no longer extant.

On 25 September, 1966, while collecting for my survey of the aquatic plants of Louisiana, I encountered the species in Old River, LaSalle Parish, Louisiana. Subsequent finds by myself, as well as by Dr. John Thieret of the University of Southwestern Louisiana and Dr. E. R. Barrett of Northeast Louisiana State College, have shown that the species is present also in Grant and Rapides Parishes and that it apparently is firmly established and growing

in abundance. It is generally found in shallow, fairly quiescent, open water in the type of habitat occupied by *Bacopa rotundifolia* (Michx.) Wettst., with which it is frequently intermingled and which it superficially resembles. Specimens of my material were sent to NY for comparison with Hale's and, according to Mr. Holmgrem, Hale's " . . . match up with your collection almost to a tee."

Previous authors, basing their comments on Hale's specimens, considered the species to be a "ballast waif" and "transient" in the United States. The recent finds refute this and the taxon should be added to our flora. Catahoula Lake, in which the species is firmly established, is a major stopover location for waterfowl migrating in the Mississippi flyway and it seems reasonable to assume the species was introduced from South America through transport by birds, as suggested by Pennell (1935).

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CHROMOSOME NUMBERS IN THE COMPOSITAE: WEST INDIAN SPECIES

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Chromosome numbers for 40 collections of Compositae from Dominica, West Indies are presented in Table 1. Bud material was collected by the junior author during December of 1967. All counts were made by the senior author. Identifications were made by the junior author except for *Conyza* (by J. Cuatrecasas). Voucher specimens are deposited in the herbaria of the U. S. National Museum and Southern Methodist University. Counts for species indicated by an asterisk are being reported for the first time.

TABLE I. SPECIES EXAMINED FOR CHROMOSOME NUMBER

Species	Locality and voucher	*n* number
Ageratum conyzoides L.	St. George: Roseau. *King 6289.*	20
Ageratum conyzoides L.	St. George: Fond Baron Estate. *King 6299.*	20
Ageratum conyzoides L.	St. George: Bellevue. *King 6303.*	20
Ageratum conyzoides L.	St. George: Tête Morne. *King 6323.*	20
Ageratum conyzoides L.	St. Paul: 1 mi NE of Springfield Estate. *King 6340.*	20
Ageratum conyzoides L.	St. Paul: 1 mi NE of Pont Cassé. *King 6350.*	20
Bidens pilosa L.	St. Patrick: Berekua, Grand Bay. *King 6319.*	36
Bidens pilosa L.	St. Paul: 1 mi NE of Springfield Estate. *King 6334.*	24
Bidens pilosa L.	St. Paul: 2-3 mi W of Springfield Estate. *King 6337.*	24
**Clibadium erosum* DC.	St. George: Bellevue. *King 6305.*	16
**Clibadium erosum* DC.	St. Patrick: 3 mi S of LaRonde. *King 6362.*	16
**Clibadium erosum* DC.	St. Patrick: 2 mi N of LaPlaine. *King 6373*	16
**Clibadium erosum* DC.	St. Joseph: Glasham. *King 6396.*	16
Conyza bonariensis (L.) Cronq.	St. Luke: 2 mi N of Pointe Michel. *King 6310.*	27

[1] Field work supported by the Bredin-Archbold-Smithsonian Biological Survey of Dominica.

**Conyza bonariensis* (L.) Cronq. var. *leiotheca* (S. F. Blake) Cuatr.	St. George: Fresh Water Lake. *King 6382.*	27
Erechtites valerianaefolia DC.	St. George: Fond Baron Estate. *King 6302.*	ca. 20
**Eupatorium impetiolare* Griseb.	St. George: Fresh Water Lake. *King 6384.*	10
**Eupatorium mononeuron* Urb.	St. George: Bellevue. *King 6313.*	10
**Eupatorium mononeuron* Urb.	St. Paul: 2-3 mi W of Springfield Estate. *King 6342.*	10
**Eupatorium mononeuron* Urb.	St. Paul: 7 mi NE of Springfield Estate. *King 6345.*	10
**Eupatorium mononeuron* Urb.	St. David: Belle Fille. *King 6355.*	10
**Eupatorium mononeuron* Urb.	St. Patrick: Grand Fond. *King 6376.*	10
**Eupatorium mononeuron* Urb.	St. Joseph: Glasham. *King 6395.*	10
Eupatorium odoratum L.	St. Patrick: Carib Point. *King 6327.*	ca. 40
Mikania micrantha H.B.K.	St. George: Fond Colet. *King 6392.*	19[a]
Mikania micrantha H.B.K.	St. Luke: 2 mi N of Point Michel. *King 6311.*	19[a]
Mikania micrantha H.B.K.	St. David: Belle Fille. *King 6354.*	20[b]
Mikania micrantha H.B.K.	St. Joseph: Carholm Estate. *King 6393.*	19[a]
Neurolaena lobata (L.)Br.	St. David: La Crête Riviere Ciriques. *King 6377.*	11
Parthenium hysterophorus L.	St. George: Goodwill. *King 6288.*	17
Parthenium hysterophorus L.	St. Patrick: Berekua, Grand Bay. *King 6318.*	17
**Senecio lucidus* DC.	St. George: Fresh Water Lake. *King 6379.*	ca. 50
Sonchus oleraceus L.	St. Patrick: Tête Morne. *King 6325.*	16
Synedrella nodiflora (L.) Gaertn.	St. Patrick: Fond St. Jean. *King 6328.*	19 or 20
Tithonia diversifolia A. Gray	St. Paul: 7 mi NE of Springfield Estate. *King 6343.*	17
Tridax procumbens L.	St. Luke: Pointe Michel: *King 6388.*	18
**Verbesina gigantea Jacq.*	St. Paul: 2-3 mi W of Springfield Estate. *King 6338.*	17
Vernonia cinerea (L.) Less.	St. Patrick: Fond St. Jean. *King 6329.*	9
Wedelia trilobata (L.) Hitch.	St. Paul: Ponte Cassé. *King 6356.*	28+1
Wulffia baccata (L. *f.*) Kuntze	St. George: Bellevue. *King 6314.*	ca. 30

[a] Numerous cells with 19 clear bivalents; cells with 17 bivalents and 1 ring quadrivalent rather consistent, especially in *King 6292* and *6393*.

[b] Few cells with 20 clear bivalents; frequently 18 bivalents and 1 quadrivalent (chain or ring of four).

STUDIES IN THE COMPOSITAE-EUPATORIEAE, IX. A REVIEW OF THE GENUS EUPATORIUM SECTION HEBECLINIUM IN COLOMBIA

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In view of the ease with which the *Eupatorium* section *Hebeclinium* can be distinguished, and because of the new species, and the new records that have been discovered, this treatment of the nine species now known from Colombia is provided. The most recent previous study of *Eupatorium* in Colombia (B. L. Robinson 1918) included only four species of the group. The species included in the section *Hebeclinium* are distinguished from other Eupatoriums by having convex to conical receptacles bearing hairs which are sometimes in a dense tuft. These species, however, are of diverse types and may not represent a natural group.

The present study is based on material in the United States National Herbarium. We wish to thank Dr. Jose Cuatrecasas for providing material and suggestions.

The following key to the species utilizes both macroscopic and microscopic characters. Microscope slides of flowers have been made using Hoyer's solution as in previous studies (King & H. Robinson, 1966).

KEY TO SPECIES

1a. Leaves with winged auriculate-based petioles; florets 200 - 300 . . . . . *E. nemorosum*

1b. Petioles not winged, florets less than 100 2

2a. Inner surface of corolla tube bearing hairs 3

2b. Inner surface of corolla tube glabrous 5

3a. Stems and leaves with dense, long white silky pubescence . . . . . *E. sericeum*

3b. Stems and leaves with short and sparse pubescence 4

4a. Tips of pappus setae distinctly enlarged, corolla reddish distally . . . . . *E. cuatrecasasii*

4b. Tips of pappus setae not distinctly enlarged, corolla pale throughout . . . . . *E. guevarae*

5a. Leaves lanceolate to narrowly ovate with dense brownish pubescence below, upper surface usually densely minutely papillose, tips of pappus setae distinctly enlarged . . . . . *E. phoenicticum*

5b. Leaves very broadly ovate to cordate, sparsely pubescent, not papillose, tips of setae not distinctly enlarged 6

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6a. Phyllaries distinctly pubescent on the outer surface 7
6b. Phyllaries essentially glabrous on the outer surface 8
7a. Inner phyllaries sharply pointed, leaves coarsely crenulate-dentate . . . . . *E. macrophyllum*
7b. Phyllaries usually blunt, leaves serrate to serrulate . *E. guapulense*
8a. Leaf margins coarsely crenulate, achenes bearing setae above . . . . . *E. erioclinium*
8.b. Leaf margins minutely serrulate, achenes without setae . . . . . *E. torondoyense*

Eupatorium nemorosum Klatt, as shown in the key, is a very distinct species and probably only remotely related. In addition to the characters cited above it alone of the nine species has only glands and no hairs on the corolla. Flowers that have been examined carefully show another character that seems unusual, the filaments in each flower are inserted at varying levels on the corolla.

Eupatorium torondoyense Badillo has been known previously only from Venezuela (Aristeguieta, 1964). As indicated below, the species is well represented in northeast Colombia with some collections having been made at least as early as 1927. The species has been confused with *E. macrophyllum* L. and *E. erioclinium* B. L. Robinson, both of which are closely related.

COLOMBIA: Magdalena, Cincinnati, *J. Giacometto 81*; Norte de Santander, Loso and vicinity (north of Toledo); alt. 2200-2400 m, *Killip* and *Smith 20364*; Santander, Rio Surata valley above Surata; alt. 2000-2300 m *Killip* and *Smith 16723*; vicinity of California; alt. 2200 m *Killip* and *Smith 17101*; vicinity of La Baja; alt. 3000 m *Killip* and *Smith 18133, 18356*; southern slope of Mount San Martin, near Charta; alt. 2300-2500 m *Killip* and *Smith 19144*.

Eupatorium **guevarae** R. M. King and H. Robinson sp. nov.

Suffrutex pauci-ramosus, erectus; folia opposita, petiolata; laminae late-ovatae, breviter acuminatae, dentato crenatae usque ad 5 cm latae, 8 cm longae; capitula ca. 20 flora; receptaculum parce pilosum, convexiusculum, corollae sordide albidae?, tubulo intus setifero; pappi setae 35-40, apice non incrassatae; achenia 4-5 costata, pauce glandulosa.

Suffrutescent shrub *ca.* ¾ meter tall; stem single, erect, striate, glabrous to sparingly pubescent; leaves thin, glabrous, opposite, petioled; leaf blades broadly ovate, sometimes cordate, up to 5 cm wide and 8 cm long; veins of leaf very prominent on the under surface; leaf margins dentate-crenate; inflorescence a loose cymose-panicle; heads discoid, campanulate, *ca.* 5 mm broad; *ca.* 8 mm tall (including style branches); receptacle convex, with sparse hairs, *ca* 20 flowered; phyllaries 3 nerved, 30-35, in 4-5 series, broadly lanceolate with a rather blunt apex; margin of phyllaries very finely serrulate; florets pale? narrowly funnel-form, *ca* 3 mm long (including lobes), 5 lobed; lobes nearly twice as long as wide, outer surface with several prominent multicellular uniseriate hairs and a few glands, the rest of the outer surface glabrous; inner surface of corolla tube bearing several rather long uniseriately multicellular hairs; stamens 5, appendaged; pappus of

Plate I. *Eupatorium guevarae* R. M. King and H. Robinson. Holotype (US), *R. M. King* and *A. E. Guevara 6183*.

35-40 setae scarcely enlarged at the tips, *ca* 3 mm long; achenes prismatic, 4-5 ribbed, glabrous below with a few glands above; base of achene enlarged and differentiated into a distinct carpopodium; pollen spherical, tricolpate, distinctly spinose, *ca* 17μ in diameter; chromosome number determined as $n = 10$ (Powell and King 1968).

Holotype in the United States National Herbarium (2502393) *R. M. King* and *A. E. Guevara 6183*. COLOMBIA: Eastern Cordillera, Territory of Putumayo. "EL Mirador," *circa* 50 kms generally east of San Francisco. Elevation 2100 meters.

The species is very closely related to *E. cuatrecasasii* n. sp. and differences are indicated under that species. The species is named for Alvaro E. Guevara, a teacher from Alexandria, Virginia, who accompanied the senior author on his collecting trip to Colombia.

Eupatorium **cuatrecasasii** R. M. King and H. Robinson sp. nov.

Suffrutex pauci-ramosus, erectus; folia opposita, petiolata; laminae late-ovatae, breviter acuminatae, dentato-crenatae usque ad 8 cm latae, 10 cm longae; capitula ca 20 flora; receptaculum dense pilosum, conicum; corollae rubellae, tubulo intus setifero; pappis setae 35-40, apice incrassatae; achenia 4-5 costata, angulis parce scabrido-setosis.

Suffrutescent shrub 3 m tall; stem, leaves, pollen similar to *E. guevarae* but stems rather densely pubescent, leaves densely pubescent on the veins, up to 8 cm wide and 10 cm long; inflorescence a loose cymose-panicle; heads discoid, campanulate *ca* 5 mm broad *ca* 7 mm tall (including style branches); receptacle very conical with a tuft of numerous long hairs, *ca* 20 flowered; phyllaries 5-7 nerved, 30-35, in 5-6 series, broadly lanceolate with a blunt apex, margin of phyllaries very finely serrulate; florets red-violet in upper part, narrowly funnelform, *ca* 3¼ mm long (including lobes), 5 lobed; lobes more than twice as long as wide, outer surface of corolla glabrous below, with glands on the lobes; inner surface of corolla tube bearing several rather long uniseriately multicellular hairs; stamens 5, appendaged; pappus of 35-40 setae very much enlarged at the tips, *ca* 3 mm long; achenes prismatic, 4-5 ribbed, dark brown, with setae; base of achene enlarged and differentiated into a distinct carpopodium; chromosome number not determined.

Ho'otype in the United States National Herbarium (2270091) *J. Cuatrecasas 15607*. COLOMBIA: Cordillera Occidental, Departamento del Valle, vertiente occidental, Hoya del rio Sanquinini, lado izquierdo, La Laguna, bosques, 1,250-1,400 m alt.

The species is another of the many apparent endemics collected Dr. Jose Cuatrecasas in the lowlands along the Pacific coast of Colombia. The species is very closely related to *Eupatorium guevarii* n. sp. which is presently known only from Putumayo on the eastern slopes of the cordilleras. *Eupatorium cuatrecasasii*, in spite of the close relationship, differs from *E. guevarae* by somewhat hairier stems and leaf veins, enlarged tips on the pappus setae, a reddish corolla, and numerous glands without evident hairs on the

Plate II. *Eupatorium cuatrecasasii* R. M. King and H. Robinson. Holotype (US), *J. Cuatrecasas 15607.*

outside of the corolla lobes. If the hairs on the inside of the corolla tube are any indication, the two species are probably most closely related to *E. sericeum* H.B.K., but such relationship is evidently still rather remote.

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STUDIES IN THE COMPOSITAE-EUPATORIEAE, X. A NEW SPECIES OF HELOGYNE NUTTALL

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Among the specimens collected during the University of California (Berkeley) Seventh Botanical Garden Expedition to the Andes in 1964, is an apparently undescribed species of the xerophytic genus *Hologyne*. Material of this Peruvian species was originally submitted to Dr. Jose Cuatrecasas, who after determining its relationship to *Hologyne* passed it on to the senior author.

HELOGYNE **hutchisonii** R. M. King and H. Robinson sp. nov. Suffruticosa ad 25 cm alta, ramosissima, dense hirsuta; folia alterna, elliptica, integra, obtusa, breve petiolata, ad 1 cm longa et 3.5 mm lata; margine plerumque reflexa; capitula ca. 12 flora; involucro anguste campanulato, squamis 2-seriatis imbricatis subaequalibus, obovatis, breve acutis; receptaculum convexiusculum nudum; corollae luteolae, anguste tubulosae, extus dense glandulosae, ad 4 mm longae; pappi setae ca. 20, subplumosae, ad 2 mm longae; achaenia 5-6 costata, glandulosa.

Shrub or subshrub to ¼ meter tall; very branched, stems, leaves, and phyllaries covered with coarse whitish pubescence; leaves alternate, elliptical, entire, obtuse, short petiolate, up to 1 cm long and 3.5 mm wide; margins usually somewhat reflexed; heads small with ca 12 flowers; involucre narrowly campanulate; phyllaries in two series, imbricated, subequal, obovate, shortly acute; receptacle convex, naked; corollas yellowish, up to 4 mm long, narrowly tubular with 5 rather short blunt lobes; anthers with short broad appendages; pappus with *ca* 20 subplumose setae, up to 2 mm long; achenes 5-6 ribbed, with numerous glands, chromosome number not determined.

Holotype in the United States National Herbarium (2577073) PERU: Department of Arequipa, lomas de Atico, km. 722 south of Lima. Elevation 10 meters. *Paul C. Hutchison* and *J. Kenneth Wright 7126*, 23 November 1964. Isotypes UC, USM, F.

The new species has rather short, subplumose pappus setae and short appendages on the anthers similar to those of *H. apaloidea* Nutt. and *H. macrogyne* (Phil.) B. L. Robinson. Of these latter species, *H. macrogyne* differs by the unequal phyllaries. *Helogyne apaloidea*, the type species of the genus, seems closest to *H. hutchisonii* but has narrow toothed or lobed leaves and has narrower sometimes lanceolate phyllaries.

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Plate I. *Helogyne hutchisonii* R. M. King and H. Robinson Holotype (US), *P. C. Hutchison* and *J. K. Wright 7126.*

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STUDIES IN THE COMPOSITAE-EUPATORIEAE, XI. TYPIFICATION OF GENERA

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This paper constitutes the first step in a plan to revise the genera of the tribe Eupatorieae. Recent work in the tribe has indicated numerous unnatural generic concepts and revealed a number of possibly undescribed genera. In a few cases it has been possible to describe new genera with review of limited complexes within the tribe (King, 1965, 1967, 1968; King and Robinson, 1966). For proper evaluation of a number of additional elements within the Eupatorieae, however, a complete review of the existing genera of the tribe is necessary. The present treatment does not reflect some taxonomic changes that are known to be necessary. Existing published conclusions are accepted here as given. There has seemed to be little question in the typification of most of the genera, however, in such work it is always possible to overlook previous typification. This information is provided at this time with the hope that such errors will be called to our attention to be incorporated in the final work.

This work has involved the use of the extensive facilities of the National Agriculture Library, the Library of Congress, and the Smithsonian Library in Washington as well as reference to the New York Botanical Garden, Royal Botanic Gardens Kew, and the British Museum (Natural History), and we wish to acknowledge the cooperation of members of the staff of each of these institutions. In addition we wish to thank Mrs. Ida K. Langman and Mrs. Virginia S. Spevak of the Index Nominum Genericorum (Plantarum) for their many helpful suggestions. In the case of certain genera indicated by an asterisk we have not seen the original publication but have relied on Mrs. Langman to supply the information. We wish to thank Drs. John Wurdack, Rogers McVaugh, and Arthur Cronquist for reading and commenting upon earlier versions of the manuscript.

In the text the ≡ sign has been used to indicate concepts that are completely equal being based on the same type. We have followed the practice of considering Necker names illegitimate except when validated by later authors.

Addisonia H. H. Rusby, Bull. Torrey Bot. Club 20: 432. 1893.

T.: *A. virgata* H. H. Rusby

Originally monotypic.

Adenostemma J. R. and G. Forster, Char. Gen. Pl. 89. 1776.

T.: *A. viscosa* J. R. and and G. Forster

Originally monotypic.

Adenostyles Cassini, Dict. Sci. Nat. 1, Suppl. 59. 1816
L.T.: *A. viridis* Cassini (≡ *A. alpina* (Willdenow) Bluff & Fing)
Three species are included in the original citation without any obvious preferences indicated. Other things being about equal, we have selected the most widely distributed species, *A. viridis*, as lectotype. Placed in the tribe Senecioneae on the basis of rather convincing evidence by Toman, Harmatha, and Novotny (1968).

**Adenostylium* Reichenbach, Ic. Fl. Germ. 16: 895. 1853.
Superfluous revised spelling for *Adenostyles* Cassini.

Ageratella A. Gray *ex* S. Watson, Proc. Am. Acad. 22: 419. 1887.
T.: *Ageratum microphyllum* Schultz-Bipontinus
Originally monotypic.

Ageratina Spach, Hist. Veg. Phan. 10: 286. 1841.
L.T.: *Eupatorium aromaticum* Linnaeus
Three species appear in the original publication. Since no preferences are obvious, we have selected as lectotype a well-known Linnaean species.

Ageratina O. Hoffmann, Engl. Jahrb. 23: 503. 1900.
T.: *A. goetzeana* O. Hoffmann
Originally monotypic. The name is a later homonym of *Ageratina* Spach. See *Ageratinastrum* J. Mattfeld.

Ageratinastrum J. Mattfeld, Notizbl. Bot. Gart. Berlin 11: 412. 1932.
T.: *Ageratina goetzeana* O. Hoffmann
New name for *Ageratina* O. Hoffmann.

Ageratiopsis Schultz-Bipontinus *ex* Bentham & J. D. Hooker, Gen. Pl. 2: 246. 1873.
T.: *Eupatorium ageratoides* Linnaeus *f.*
Nom. nud., cited only in synonymy.

Ageratum Linnaeus, Sp. Pl. 2: 839. 1753.
L.T.: *Ageratum conyzoides* Linnaeus
The lectotype species is the first of three listed by Linnaeus. The lectotype is indicated by Cabrera and Vittet (1963) but it may have been specified by earlier authors also.

Agrianthus Martius *ex* A. P. Decandolle, Prod. 5: 125. 1836.
L.T.: *Agrianthus campestris* Martius *ex* A. P. Decandolle
The lectotype species was the first cited of the original two of Martius, and the only one of the original species placed in the subgenus *Euagrianthus* by Mattfeld (1923).

Alomia Humboldt, Bonpland and Kunth, Nov. Gen. et Sp. 4: 151. 1820.
T.: *A. ageratoides* Humboldt, Bonpland and Kunth
Originally monotypic.

Amboroa Cabrera, Bol. Soc. Argent. Bot. 6: 91. 1956.
T.: *A. geminata* Cabrera
Originally monotypic.

Ammopursus J. K. Small, Bull. Torrey Bot. Club 51: 392. 1924.
T.: *Lacinaria ohlingerae* S. F. Blake
Originally monotypic.

Anisochaeta A. P. Decandolle, Prod. 5: 109. 1836.
T.: *A. mikanoides* A. P. Decandolle
Originally monotypic. Placed in the tribe Mutisieae by Bentham and Hooker (1873).

Apodocephala Baker, Jour. Linn. Soc. 21: 417. 1885.
T.: *A. pauciflora* Baker
Originally monotypic. Placed in the tribe Vernonieae by Hoffmann (1894) and B. L. Robinson (1906).

Arrojadoa J. Mattfeld, Notizbl. Bot. Gart. Berlin 8: 434. 1923.
T.: *A. praxeloides* J. Mattfeld
Originally monotypic. The name is a later homonym of *Arrojadoa* Britton and Rose of the Cactaceae. See *Arrojadocharis* J. Mattfeld.

Arrojadocharis J. Mattfeld, Notizbl. Bot. Gart. Berlin 10: 1053. 1930.
T.: *Arrojadoa praxeloides* J. Mattfeld
New name for *Arrojadoa* J. Mattfeld.

Aschenbornia Schauer, Linnaea 19: 716. 1847.
T.: *A. heteropoda* Schauer
Originally monotypic.

Ascidiogyne J. Cuatrecasas, Ann. Missouri Bot. Gard. 53: 310. 1965.
T.: *A. wurdackii* J. Cuatrecasas
Originally monotypic.

Barroetea A. Gray, Proc. Am. Acad. 15: 29. 1880.
L.T.: *B. setosa* A. Gray
We have selected as lectotype the first of two species cited by Gray. The other species, *B. subuligera* (Schauer) A. Gray, was cited by Gray only from its description and from one head (capitulum) sent from Berlin.

Batschia Moench, Meth. 567. 1794.
T.: *B. nivea* Moench (≡ *Eupatorium ageratoides* Linnaeus *f.*)
Originally monotypic. The name is a homonym of *Batschia* Gmelin, 1791 (Boraginaceae); *Batschia* Mutis *ex* Thunberg, 1792 (Menispermaceae); and *Batschia* Vahl, 1794 (Leguminosae). See *Ageratina* Spach.

Biolettia E. L. Greene, Pittonia 2: 216. 1891.
T.: *B. riparia* E. L. Greene
Originally monotypic.

Brachyandra R. A. Philippi, Fl. Atac. 34. 1860.
T.: *B. macrogyne* R. A. Philippi
Nom. cons. Originally monotypic.

Brickellia S. Elliott, Sketch Bot. S. Car. and Ga. 2: 290. 1822 ? ("1824").
T.: *B. cordifolia* S. Elliott
Nom. cons. Originally monotypic.

Bulbostylis A. P. Decandolle, Prod. 5: 138. 1836.
L.T.: *Coleosanthus cavanillesii* Cassini (= *Brickellia cavanillesii* (Cassini) A. Gray)
We have selected as lectotype the first of the eleven species cited by Decandolle. The name is a later homonym of *Bulbostylis* Kunth, *nom. cons.* (Cyperaceae).

Caelestina Cassini, Dict. Sci. Nat. 6, Suppl. 8. 1817.
T.: *C. coerulea* Cassini
Originally monotypic. See *Coelestina* Cassini.

Calostelma D. Don *in* Sweet, Brit. Flow. Gard. 2: no. 184 p. 2. 1833.
T.: *Staehelina elegans* T. Walter
Originally monotypic. The combination in *Calostelma* has never been validly made. The species is presently placed in *Liatris* Gaertner *ex* Schreber.

Campuloclinium A. P. Decandolle, Prod. 5: 136. 1836.
L.T.: *Eupatorium macrocephalum* Lessing
Barroso (1950), by excluding all others of the original species from the group, accomplished a de facto typification of *Campuloclinium.*

Carelia G. Pontedera *ex* P. C. Fabricius, Enum. 85. 1759.
L.T.: *Ageratum conyzoides* Linnaeus
Fabricius seems to have been the first to validate this pre-Linnaean name. No species was cited by Fabricius, but *Ageratum* Linnaeus was given as a synonym. The identity of the two genera is reflected in the lectotypification by Britton and Wilson (1925).

Carelia A. L. Jussieu *ex* Cavanilles, Anal. Cienc. Nat. 6. 1802 (1803).
T.: *C. satureiaefolia* Cavanilles (= *Mikania amara* Willdenow)
Originally monotypic. The name is a later homonym of *Carelia* Fabricius listed above.

Carelia Lessing, Syn. Comp. 156. 1832.
T.: *C. cistifolia* Lessing
Originally monotypic. The name is a later homonym of *Carelia* Fabricius listed above. For new name see *Radlkoferotoma* Kuntze.

Carminatia Mocino *ex* A. P. Decandolle, Prod. 7: 267. 1838.
T.: *C. tenuiflora* A. P. Decandolle
Originally monotypic.

Carphephorus Cassini, Bull. Soc. Philom. 1816: 198. 1816.
T.: *C. pseudoliatris* Cassini
Originally monotypic.

Carphochaete A. Gray, Mem. Am. Acad. n.s. 4: 65. 1849.
T.: *C. wislizeni* A. Gray
Originally monotypic.

Carterothamnus R. M. King, Rhodora 69: 45. 1967.
T.: *C. anomalochaeta* R. M. King
Originally monotypic.

Chone Dulac, Fl. Hautes Pyr. 512. 1867.
T.: *C. heterophylla* Dulac
Originally monotypic.

Chromolaena A. P. Decandolle, Prod. 5: 133. 1836.
T.: *C. horminoides* A. P. Decandolle
Originally monotypic.

Ciceronia Urban, Fedde Rep. 21: 324. 1925.
T.: *C. chaptalioides* Urban
Originally monotypic.

Clavigera A. P. Decandolle, Prod. 5: 127. 1836.
L.T.: *C. corymbosa* A. P. Decandolle
Since no other preference is indicated, we have selected as lectotype the first of the three species listed by Decandolle.

Coelestina Cassini, Bull. Soc. Philom. 1817: 10. 1817.
L.T.: *Caelestina coerulea* Cassini
No species was included in the original publication. For citation of the later publication see *Caelestina* Cassini. The name *Coelestina* is a later homonym of *Coelestina* J. Hill (*Aster*)

Coleosanthus Cassini, Bull. Soc. Philom. 1817: 67. 1817.
L.T.: *C. cavanillesii* Cassini (= *Brickellia cavanillesii* (Cassini) A. Gray)
The original publication included no species. The lectotype was the first species assigned to the genus in subsequent work by Cassini (1818). The name antedates that of *Brickellia*, but the latter is conserved.

Conoclinium A. P. Decandolle, Prod. 5: 135. 1836.
L.T.: *Eupatorium coelestinum* Linnaeus
We have chosen as lectotype the first of five species listed by Decandolle.

Corynanthelium Kunze, Linnaea 20: 19. 1847.
T.: *C. moronoa* Kunze
Originally monotypic.

Critonia P. Browne, Civ. Nat. Hist. Jam. 490. 1756.
T.: *Eupatorium dalea* Linnaeus
Originally monotypic. Browne described the plant on page 314 under the name *Dalea*. The name *Critonia* was given in errata on page 490.

Cronquistia R. M. King, Brittonia 20: 11. 1968.
T : *Stevia pringlei* S. Watson
Originally monotypic.

Decachaeta A. P. Decandolle, Prod. 5: 133. 1836.
T.: *D. haenkeana* A. P. Decandolle
Originally monotypic.

Dichaeta Schultz-Bipontinus, Flora 33: 419. 1850.
Nom. nud. cited only in synonymy. The name is a later homonym of *Dichae-*

ta Nuttall (*Baeria*). ≡ *Schaetzellia* Schultz-Bipontinus, *nom. illeg.*; ≡ *Macvaughiella* R. M. King and H. Robinson.

Dissothrix A. Gray, Jour. Bot. Kew Gard. Misc. 3: 223. 1851.
T.: *D. gardneri* A. Gray (≡*Dissothrix imbricata* (Gardner) B. L. Robinson)
Originally monotypic.

Disynaphia W. J. Hooker and Arnott *ex* A. P. Decandolle, Prod. 7: 267. 1838.
T.: *D. montevidensis* A. P. Decandolle
Originally monotypic.

Dyscritothamnus B. L. Robinson, Contr. Gray Herb. n.s. 65: 25. 1922.
T.: *D. filifolius* B. L. Robinson
Originally monotypic.

Ellenbergia J. Cuatrecasas, Proc. Biol. Soc. Wash. 77: 142. 1964.
T.: *E. glandulata* J. Cuatrecasas
Originally monotypic.

Eriopappus Loudon, Encyc. Pl. 688. 1839.
Nom. nud. cited only in synonymy. =*Eupatorium paniculatum sensu* Loudon. The name is a later homonym of *Eriopappus* Arnott (*Layia*).

Ethulia Linnaeus, Sp. Pl. ed. 2, 1171. 1763.
L.T.: *E. conyzoides* Linnaeus
The lectotype was the first of two species included in the genus by Linnaeus. Subsequent removal of the second species, *E. sparganophora*, to the genus *Sparganophorus* (see below) has resulted in de facto typification of *Ethulia*. Placed in the tribe Vernonieae by Bentham and Hooker (1873).

Eupatoriastrum J. R. Greenman, Proc. Am. Acad. 39: 93. 1903.
T.: *E. nelsonii* J. R. Greenman
Originally monotypic.

Eupatoriopsis Hieronymus, Beibl. Engl. Bot. Jahrb. 43: 46. 1893.
T.: *E. hoffmanniana* Hieronymus
Originally monotypic.

Eupatorium Linnaeus, Sp. Pl. 2: 836. 1753.
L.T.: *E. cannabinum* Linnaeus
The species is cited as lectotype by Ferris (1960) and Cabrera and Vittet (1963) among others. The earliest such citation we have seen is that of E. L. Greene (1903).

Ferreyrella S. F. Blake, Jour. Wash. Acad. Sci. 47: 407. 1958.
T.: *F. peruviana* S. F. Blake
Originally monotypic.

Fleischmannia Schultz-Bipontinus, Flora 33: 417. 1850.
T.: *F. rhodostyla* Schultz-Bipontinus (= *F. arguta* (Humboldt, Bonpland and Kunth) B. L. Robinson)
Originally monotypic.

Garberia A. Gray, Proc. Acad. Sci. Phila. 379. 1879 (1880).
T.: *Liatris fruticosa* Nuttall

Originally monotypic. New name for *Leptoclinium* (Nuttall) A. Gray.

Gymnocoronis A. P. Decandolle, Prod. 5: 106. 1836.
L.T.: *G. attenuata* A. P. Decandolle
We have selected as lectotype the first of two species listed by Decandolle.

Gyptis (Cassini) Cassini, Dict. Sci. Nat. 16: 10. 1820.
T.: *G. pinnatifida* Cassini
Originally monotypic.

Haberlea Pohl *ex* Baker *in* Martius, Fl. Bras. 6(2): 341. 1876.
Nom. nud., cited only in synonymy. =*Eupatorium* sect. *Praxelis* Bentham *sensu* Baker.

Hartwrightia A. Gray *ex* S. Watson, Proc. Am. Acad. 23: 264. 1888.
T.: *H. floridana* A. Gray *ex* S. Watson
Originally monotypic.

Hebeclinium A. P. Decandolle, Prod. 5: 136. 1836.
L.T.: *Eupatorium macrophyllum* Linnaeus
The lectotype species is the first and by far the most common of the three listed by Decandolle.

Helogyne Nuttall, Trans. Am. Phil. Soc. n.s. 7: 449. 1841.
T.: *H. apaloidea* Nuttall
Originally monotypic.

Helogyne Bentham, Bot. Voy. Sulph. 20. 1844.
T.: *H. fasciculata* Bentham
Originally monotypic. The name is a later homonym of *Helogyne* Nuttall (see above). For new name see *Hofmeisteria* Walpers.

Heterolaena Schultz-Bipontinus *ex* Bentham and J. D. Hooker, Gen. Pl. 2: 245. 1873.
L.T.: *Eupatorium odoratum* Linnaeus
Nom. nud., cited only in synonymy. We have chosen the lectotype to coincide with that of *Osmia* with which the name is considered synonymous.

Hofmeisteria Walpers, Walp. Rep. 6: 106. 1847.
T.: *Helogyne fasciculata* Bentham
New name for *Helogyne* Bentham.

Homogyne Cassini, Bull. Soc. Philom. 1816: 198. 1816.
L.T.: *Tussilago alpina* Linnaeus
Of the three original species, *Homogyne alpina* (Linnaeus) Cassini was considered especially representative by Cassini, and has been called the type by Greene (1905). Placed in the tribe Senecioneae by Bentham and Hooker (1873).

Ismaria Rafinesque, Sylva Tellur. 117. 1838.
T.: *I. glandulosa* Rafinesque
Originally monotypic. Superfluous new name for *Rosalesia* La Llave.

Isocarpha R. Brown, Trans. Linn. Soc. 12: 110. 1817.
T.: *Calea oppositifolia* Linnaeus

Originally monotypic. Placed in the tribe Helianthoideae by Bentham and Hooker (1873).

Jaliscoa S. Watson, Proc. Am. Acad. 25: 153. 1890.
T.: *J. pringlei* S. Watson
Originally monotypic.

Kahiria P. Forskal, Fl. Aegypt Arab. 153. 1775.
No species listed with description. Placed in the tribe Vernonieae by Bentham and Hooker (1873) as a synonym of *Ethulia conyzoides* Linnaeus.

Kallophyllon Pohl *ex* Baker *in* Martius, Fl. Bras. 6(2): 365. 1876.
Based on *K. crenatum* Pohl and *K. ovatum* Pohl, *nom. nud.*
Nom. nud., cited only in synonymy. ≡ *Symphyopappus* Turczaninow.

Kanimia G. Gardner, Lond. Jour. Bot. 6: 446. 1847.
L.T.: *Mikania strobilifera* G. Gardner
We have selected as lectotype the second listed but older species of the two included by Gardner. The other species, *K. palustris* G. Gardner, was described new with the genus.

Kuhnia Linnaeus, Sp. Pl. ed. 2. 1662. 1763.
T.: *K. eupatorioides* Linnaeus
Originally monotypic.

Kyrstenia Necker *ex* E. L. Greene, Leafl. Bot. Obs. Crit. 1: 8. 1903.
L.T.: *Eupatorium aromaticum* Linnaeus
We have selected as lectotype the first of the two species considered as typical by Greene.

Lacinaria J. Hill, Veg. Syst. 4: 49. 1772.
L.T.: *Serratula squarrosa* Linnaeus
The genus originally included two species. The lectotypification has been credited to Britton and Brown (Jones, 1930), and coincides with the type of *Liatris* Gaertner *ex* Schreber. The genus name antedates that of *Liatris*, but the latter is conserved.

Lavenia Swartz, Prod. Veg. Ind. Occ. 112. 1788.
L.T.: *L. erecta* Swartz
We have selected as lectotype the second of two species listed by Swartz. This is selected since Swartz obviously derived the generic name from *Verbesina lavenia* Linnaeus which he cited as a synonym of *Lavenia erecta.*

**Leighia* Scopoli, Introd. 128. 1777.
No species cited with description. = *Ethulia conyzoides* Linnaeus which is placed in the tribe Vernonieae by Bentham and Hooker (1873).

Lepidesmia Klatt, Bull. Herb. Boiss. 4: 479. 1896.
T.: *L. squarrosa* Klatt
Originally monotypic. Placed in the tribe Heliantheae by B. L. Robinson (1911).

Leptoclinium (Gardner) Bentham *in* Bentham and J. D. Hooker, Gen. Pl. 2: 244. 1873.
T.: *Liatris* (*Leptoclinium*) *brasiliensis* Gardner

Originally monotypic.

Leptoclinium (Nuttall) A. Gray, Proc. Am. Acad. 15: 48. 1879.

T.: *Liatris* (*Leptoclinium*) *fruticosa* Nuttall

Originally monotypic. The name is a later homonym of *Leptoclinium* (Gardner) Bentham listed above. The Gardner use of the subgeneric name *Leptoclinium* was intended as an extension of the original concept of Nuttall. The elevation to generic rank by Bentham on the basis of Gardner's species, however, antedated the similar action of Gray. For new name see *Garberia* A. Gray.

**Leto* R. A. Philippi, Anal. Mus. Nac. Chile 33. 1891.

T.: *L. tenuifolia* R. A. Philippi

Originally monotypic. Considered a synonym of *Brachyandra* R. A. Philippi, an earlier and conserved name.

Liatris J. Gaertner *ex* Schreber, Gen. 2: 542. 1791.

T.: *Serratula squarrosa* Linnaeus

Nom cons. The authorship of the combination *Liatris squarrosa* is credited to A. Michaux.

Litrisa J. K. Small, Bull. Torrey Bot. Club 1: 392. 1924.

T.: *L. carnosa* J. K. Small

Originally monotypic.

Lomatozoma Baker *in* Martius, Fl. Bras. 6: 198. 1876.

T.: *L. artemisiaefolia* Baker *in* Martius

Orignally monotypic.

Lycapsus R. A. Philippi, Bot. Zeit. 28 (1): 499. 1870.

T.: *L. tenuifolius* R. A. Philippi

Originally monotypic.

Macvaughiella R. M. King and H. Robinson, Sida 3: 282. 1968.

T.: *Schaetzellia mexicana* Schultz-Bipontinus

New name for *Schaetzellia* Schultz-Bipontinus

Mallinoa Coulter, Bot. Gaz. 20: 47. 1895.

T.: *M. corymbosa* Coulter

Originally monotypic. Placed provisionally in the tribe Inuleae by Coulter.

Malperia S. Watson, Proc. Am. Acad. 24: 54. 1889.

T.: *M. tenuis* S. Watson

Originally monotypic.

Margacola Buckley, Proc. Acad. Sci. Phila. 1861 [v. 13]: 457. 1862.

T.: *M. parvula* Buckley (= *Trichocoronis wrightii* A. Gray)

Originally monotypic.

Mexianthus B. L. Robinson, Contr. Gray Herb. n.s. 29: 5. 1925.

T.: *M. mexicanus* B. L. Robinson

Originally monotypic.

Mikania Willdenow *in* Linnaeus, Sp. Pl. (ed. 4) 3(3): 1742. 1803.

L.T.: *Eupatorium scandens* Linnaeus, *typ. cons.*
Nom. cons. Eupatorium hastatum Linnaeus has been cited as type by Britton and Brown (Jones, 1960) and Cabrera and Vittet (1963).

Moronoa Kunze, error for *Morrenia*, see below.

Morrenia Hortulanorum *ex* Kunze, Linnaea 20: 19. 1847. (error *Moronoa*)
T.: *Morrenia odorata* Kunze, *nom. nud.*, cited only in synonymy.
Nom. nud., cited only in synonymy of *Corynanthelium moronoa* Kunze.
Originally monotypic.

Mustelia C. Sprengel, Nachtr. I, Bot. Gart. Halle 28. 1801.
T.: *M. eupatoria* C. Sprengel
Originally monotypic.

Nardosmia Cassini, Dict. Sci. Nat. 34: 186. 1825.
L.T.: *N. denticulata* Cassini (= *Tussilago* (*Petasites*) *fragrans* Villars)
We select the first of the three species listed by Cassini. Cassini makes special mention of the species in his introduction to the genus. Placed in the tribe Senecionideae by Bentham and Hooker (1873).

Nothites Cassini, Dict. Sci. Nat. 35: 163. 1825.
L.T.: *N. latifolia* Cassini (= *Stevia melissaefolium* (Lamarck) Schultz-Bipontinus)
Other things being equal we have selected as lectotype the first of the four species included by Cassini.

Oaxacania B. L. Robinson and J. Greenman, Am. Jour. Sci. ser. 3. 1: 151. 1895.
T.: *O. malvaefolis* B. L. Robinson and J. Greenman.
Originally monotypic.

Ooclinium A. P. Decandolle, Prod. 5: 133. 1836.
L.T.: *O. grandiflorum* A. P. Decandolle
We have selected as lectotype the first of the seven species listed by Decandolle.

Ophryosporus Meyen, Reise 1: 402. 1834-1835.
T.: *O. triangularis* Meyen
Originally monotypic.

Orsinia Bertoloni *ex* A. P. Decandolle, Prod. 5: 104. 1836.
T.: *O. eupatoria* A. P. Decandolle (= *Eupatorium armanii* Balbis)
Originally monotypic. The name is a later homonym of *Orsina* Bertoloni (*Inula*).

Osmia Schultz-Bipontinus, Pollachia 22-24: 251. 1866.
T.: *Eupatorium odoratum* Linnaeus
Original designation. The one species was definitely cited as the example for the genus, though innumerable other new combinations were established in the same paper.

Oxylobus (Mocino *ex* A. P. Decandolle) A. Gray, Proc. Am. Acad. 15: 25. 1879.

L.T.: *Phania trinervia* Mocino *in* Sesse and Mocino
Two species were included in the original section *Oxylobus* of *Phania*. The other species, *P. arbutifolia* (Humboldt, Bonpland and Kunth) A. P. Decandolle, was later restored to *Ageratum* by Bentham and Hooker (1873).

Phalacraea A. P. Decandolle, Prod. 5: 105. 1836.
T.: *P. latifolia* A. P. Decandolle
Originally monotypic.

Phania A. P. Decandolle, Prod. 5: 114. 1836.
T.: *P. multicaulis* A. P. Decandolle
The genus was originally divided into two sections with two species in section *Oxylobus* and only *P. multicaulis* in section *Euphania*.

Piptothrix A. Gray, Proc. Am. Acad. 21: 383. 1886.
T.: *P. palmeri* A. Gray
Originally monotypic.

Piqueria Cavanilles, Ic. Desc. Pl. 3: 18. 1794.
T.: *P. trinervia* Cavanilles
Originally monotypic.

Piqueriopsis R. M. King, Brittonia 17: 352. 1965.
T.: *P. michoacana* R. M. King
Originally monotypic.

Planaltoa Taubert, Engl. Jahrb. 21: 454. 1896.
T.: *P. salvifolia* Taubert
Originally monotypic.

Pleurocoronis R. M. King and H. Robinson, Phytologia 12: 468. 1966.
T.: *Hofmeisteria pluriseta* A. Gray
Original designation.

Podophania Baillon, Bull. Soc. Linn. Par. 1: 268. 1880.
T.: *P. ghiesbreghtiana* Baillon (= *Hofmeisteria dissecta* (W. J. Hooker and Arnott) R. M. King and H. Robinson)
Originally monotypic.

Praxeliopsis G. M. Barroso, Arquiv. Jard. Bot. Rio de Janeiro 9: 176. 1949.
T.: *P. mattogrossensis* G. M. Barroso
Originally monotypic.

Praxelis Cassini, Dict. Sci. Nat. 43: 261. 1826.
T.: *P. villosa* Cassini
Originally monotypic.

Psiloanthus Necker, Elem. 1: 69. 1790.
Nom. illeg. Placed in synonymy of *Liatris* J. Gaertner *ex* Schreber by Cassini and subsequent authors.

Radlkoferotoma Kuntz, Rev. Gen. 358. 1891.
T.: *Carelia cistifolia* Lessing
New name for *Carelia* Lessing.

Rosalesia La Llave *in* La Llave and Lexarza, Nov. Veg. Desc. 1: 14. 1824.
T.: *R. glandulosa* La Llave *in* La Llave and Lexarza (= *Brickellia cavanillesii* (Cassini) A. Gray)
Originally monotypic.

Schaetzellia Schultz-Bipontinus, Flora 33: 419. 1850.
T.: *S. mexicana* Schultz-Bipontinus
Originally monotypic. The name is a later homonym of *Schaetzellia* Klotz (*Onoseris*). For new name see *Macvaughiella* R. M. King and H. Robinson.

Sciadocephala J. Mattfeld, Notizbl. Bot. Gart. Berlin 14: 41. 1938.
T.: *S. schultze-rhonhofiae* J. Mattfeld
Originally monotypic.

Sclerolepis Cassini, Bull. Soc. Philom. 1816: 198. 1816.
T.: *Sparganophorus verticillatus* Michaux (= *Sclerolepis uniflora* (T. Walter) Porter)
Originally monotypic.

Spaniopappus B. L. Robinson, Contr. Gray Herb. n.s. 77: 45. 1926.
T.: *S. ekmanii* B. L. Robinson
Originally monotypic.

Sparganophorus S. Vaillant *ex* H. Crantz, Inst. 1: 261. 1766.
L.T.: *S. vaillantii* H. Crantz
The lectotype is the second cited of the two original species, but it is the one retained in the genus by Decandolle and later authors. The other species has been restored to the genus *Ethulia* as a synonym of *E. conyzoides* Linnaeus. *Sparganophorus* is placed in the tribe Vernonieae by Bentham and Hooker (1873).

Sphaereupatorium (O. Hoffmann) Kuntze *ex* B. L. Robinson, Contr. Gray Herb. n.s. 56: 24. 1920.
T.: *Eupatorium hoffmannii* (Kuntze) Kuntze *ex* B. L. Robinson
Originally monotypic.

Stevia Cavanilles, Ic. Desc. Pl. 4: 32. 1797.
L.T.: *S. serrata* Cavanilles
The lectotype is one of two species originally included in the genus. The typification was accomplished by Rafinesque when he removed the other species, *S. salicifolia* Cavanilles, to his new genus *Xetoligus*. Cabrera and Vittet (1963) cite *S. salicifolia* as type, but such action is considerably antedated by that of Rafinesque.

Stylotrichium J. Mattfeld, Notizbl. Bot. Gart. Berlin 8: 436. 1923.
L.T.: *Agrianthus corymbosus* A. P. Decandolle
We have selected as lectotype the older and the first listed of the two species originally included by Mattfeld (1923).

Suprago J. Gaertner, Fruct. Sem. Pl. vol. alt. 402. 1791.
L.T.: *Serratula spicata* Linnaeus (= *Liatris spicata* (Linnaeus) Willdenow)

Of the two species originally included in the genus, the first, *S. glauca* (Linnaeus) J. Gaertner, has proven to be a *Vernonia (V. novaboracensis* (Linnaeus) Michaux), the second, *S. spicata* (Linnaeus) J. Gaertner, is a *Liatris*. Decandolle (1836) excluded the former species and recognized *Suprago* as a section of *Liatris*. Bentham and Hooker (1873) excluded the later species instead, and recognized *Suprago* as a synonym of *Vernonia*. On the basis of Decandolle's earlier action we have recognized *Serratula spicata* Linnaeus as lectotype.

Symphyopappus Turczaninow, Bull. Soc. Nat. Mosc. 21: 583. 1848.

T.: *S. decussatus* Turczaninow

Originally monotypic.

Traganthes Wallroth, Sched. Crit. 1: 456. 1822.

L.T.: *Artemisia tenuifolia* Willdenow (= *Eupatorium capillifolium* (Lamarck) J. K. Small)

We select as lectotype the first of two species originally included by Wallroth. Wallroth did not actually make the combinations for either species that he included in *Traganthes*. The combinations were apparently first made by E. L. Greene (1903).

Trichocoronis A. Gray, Mem. Am. Acad. n.s. 4: 65. 1849.

L.T.: *T. wrightii* (Torrey and A. Gray *ex* A. Gray) Gray

We have selected as lectotype the older and first cited of the two species in Gray's original treatment.

Trichogonia (A. P. Decandolle) G. Gardner, Lond. Jour. Bot. 5: 459. 1846.

L.T.: *Kuhnia arguta* Humboldt, Bonpland and Kunth

We have selected as lectotype the first of the four species listed in the section *Trichogonia* of *Kuhnia* by Decandolle.

Trilisa (Cassini) Cassini, Dict. Sci. Nat. 26: 228. 1823.

T.: *Liatris odoratissima* Willdenow

Originally monotypic.

Trychinolepis B. L. Robinson, Contr. Gray Herb. n.s. 80: 6. 1928.

T.: *T. hoppii* B. L. Robinson

Originally monotypic.

Tuberostyles Steetz *in* Seemann, Bot. Voy. Herald 142. 1853.

T.: *T. rhizophorae* Steetz *in* Seemann

Originally monotypic.

Uleophytum Hieronymus, Verh. Bot. Ver. Brand. 48: 198. 1906.

T.: *U. scandens* Hieronymus

Originally monotypic.

Uncasia E. L. Greene, Leafl. Bot. Obs. Crit. 1: 13. 1903.

T.: *Eupatorium perfoliatum* Linnaeus

Original designation.

**Wikstroemia* C. Sprengel, Svensk. Vet. Akad. Handl. Stockh. 167. 1821. after May.

T.: *W. glandulosa* C. Sprengel (= *Eupatorium dalea* Linnaeus)

Originally monotypic. The name has been rejected as a homonym of *Wikstroemia* Schrader (Theaceae) May 1821, *nom. rej.*, and *Wikstroemia* Endlicher (Thymelaeaceae) *nom. cons.*

Willoughbya Necker *ex* Kuntze, Rev. Gen. Pl. 371. 1891.

T.: *Eupatorium scandens* Linnaeus (= *Mikania scandens* (Linnaeus) Willdenow)

Original designation. The name is rejected as a later homonym of *Willoughbya (Willughbeja)* Schreber *(Apocynaceae) nom. rej.*, and *Willoughbya* (*Willughbeia*) Roxburgh (Apocynaceae) *nom. cons.*

Xetoligus Rafinesque, New Fl. Am. 4: 74. 1836.

L.T.: *Stevia salicifolia* Cavanilles

We have selected as lectotype the older and the first listed of the two species included by Rafinesque.

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NOTES

BLYXA AUBERTII (HYDROCHARITACEAE) IN LOUISIANA: NEW TO NORTH AMERICA.—The aquatic angiosperm flora of Louisiana is noteworthy for the presence of *Ottelia alismoides* and *Hydranthelium egense* (*Bacopa egensis*), naturalized species unknown elsewhere in North America. To these may now be added *Blyxa aubertii* Rich., not previously reported from North America. *Blyxa*, a genus of about ten species of submerged hydrophytes, is native to the Old World tropics. According to Den Hartog (Flora Malesiana, Ser. I, Vol. 5(4): 391. 1957), *B. aubertii* ranges from "Madagascar and India, northwards to Korea and Japan, eastwards via Malaysia to New Guinea and N. Australia." It was first collected by us in Louisiana on 26 September 1968 from Lake Chicot in Chicot State Park, Evangeline Parish, where it was common locally near the boat dock. Growing with *Limnophila indica*, another introduced aquatic (recently reported also in Texas and Florida), it was rooted in clay in rather turbid water to about 2 feet deep. A visit to Lake Chicot on 12 October 1968, to collect additional material, was unrewarding inasmuch as the lake had been drained (for "weed control") and the *Blyxa* was stranded high and dry. Desiccated plants were seen at several localities on the shore. No plants were still submerged, which prompted us to throw a number of fruits into the water to thwart the "control" effort. On 17 October 1968, at Lacassine Migratory Waterfowl Refuge (about 65 miles southwest of Lake Chicot) in Cameron Parish, we found *B. aubertii* again. While, in a motor boat, we were looking for *Ottelia* in "The Pool" (an artificial impoundment of ca. 16,000 acres), a grab at some "different looking" plant material in the water yielded a handful of *Blyxa* fruiting peduncles. By the time we realized what we had, we were a considerable distance from the site; search in the general area failed to yield additional *Blyxa*. Two days later, near The Pool, we found *Blyxa* rooted in soft clay in the water in a borrow pit. Plants of all sizes were noted.

Blyxa aubertii, apparently annual with us, is easily recognized vegetatively. Its leaves, ranging in length (in our specimens) from 8 to 43 cm and in width from 0.3 to 0.8 cm, have long attenuate tips, finely and minutely serrulate margins (about 25-30 teeth per cm), and prominent midribs. We know of no other ribbon-leaved aquatic in the United States that shares these characteristics. The peduncles, up to 45 cm long, are frequently somewhat bent just below the spathe. The slightly compressed spathes, 3.5 to 6.6 cm long, are six-ribbed. The long-cylindrical fruits, usually overtopped by the persistent spathes, are from 3.5 to 4.6 cm long and are about 0.2 cm wide. A rostrum, to 8 cm long and 0.1 cm wide, remains as a beak on each fruit. The three sepals are 6.5 to 7.0 mm long; the three petals, 10 mm long and 0.5 mm wide (in all the flowers we saw, the petals were crumpled and included); the three stamens, 4.8 mm long, with the anthers 1.8 mm. The ellipsoid seeds, 1.6 to 1.8 mm long and 0.9 mm wide, have from eight to eleven irregular, tuberculate, longitudinal ridges. Although Den Hartog

Fig. 1. Illustration of *Blyxa aubertii* showing (1) a cross section of a leaf blade one-third up from the base, (2) the entire plant. The vertical line represents 6 cm.

states that *Blyxa* seeds have "3 8 longitudinal rows" of tubercles and that those of *B. aubertii* have eight ribs, his illustrations of *B. aubertii* seeds seem to show more than eight.

Voucher specimens, bearing our field numbers 30302 and 30510, have been deposited in the following herbaria: DUKE, FSU, GH, LAF, and MICH.—*John W. Thieret, Robert R. Haynes, and David H. Dike, University of Southwestern Louisiana, Lafayette 70501.*

CYPERUS GIGANTEUS (CYPERACEAE) IN FLORIDA.—The following collection is apparently the first record of the sedge *Cyperus giganteus* Vahl from Florida. Dade County: growing in and along edge of borrow pit near Gumbo Limbo Trail, Royal Palm Area, Everglades National Park, *Alex Lasseigne and Robert R. Haynes 1274*, 25 January 1968. Voucher specimens have been deposited in the herbarium of the University of Southwestern Louisiana and in the herbarium of Southern Methodist University.—*Robert R. Haynes and Alex Lasseigne, University of Southwestern Louisiana, Lafayette, Louisiana.*

TRILLIUM FLEXIPES (LILIACEAE) IN THE ARKANSAS OZARKS.—The finding of *Trillium flexipes* Raf. in the Sylamore Division of the Ozark National Forest represents a southwestward range extension of *ca.* 140 miles from the Stoddard Co., Missouri, collection site (in Steyermark, Flora of Missouri 447, 1963). Steyermark reports it as absent from most of the Ozark region.

The specimen (Graham 166) was collected 6 April, 1967, on a rich mesic slope overlooking a tributary to the North Sylamore Creek at Barkshed Recreation Area, Stone County. At that time there was a population of *ca.* twenty individuals in two close colonies mostly in bloom. Mr. Gary Tucker of Arkansas Polytechnic College in Russellville, Arkansas, had the opportunity to reobserve this population in April 1968. He reports the two colonies as having grown somewhat. The species is apparently well established at this location.

The plant was first identified by Mr. Tucker and myself. Gracious confirmation of this identification was made by Mr. Harry Ahles of the Herbarium of the University of Massachusetts and Dr. Edward Voss of the University of Michigan. Specimens are deposited in these institutions and in the Herbarium of Arkansas Polytechnic College.—*Wm. L. Graham, University of Michigan, Ann Arbor.*

HOLOSTEUM UMBELLATUM (CARYOPHYLLACEAE) REPORTED FROM MONTANA.—A 1965 collection of *Holosteum umbellatum* L. from near the city limits of Missoula, is apparently the first record of the weed from Montana. This collection, *Peter F. Stickney 1185*, was made by a Forest Service research scientist who reported the species as common and growing in an overgrazed pasture. The establishment of the species in western Montana indicates that it is continuing to spread eastward from areas in the Northwest in which it had been reported earlier. (See Sida 2: 120, 121, 125. 1965.)—*Charles Feddema, Forest Service Herbarium, Washington, D.C. 20250.*

PETRORHAGIA PROLIFERA (DIANTHUS PROLIFER, TUNICA PROLIFERA) (CARYOPHYLLACEAE) IN ARKANSAS AND TEXAS.—The correct name of this Old World annual (native primarily in mountain areas

from Central Europe to Turkey and Morocco) does not appear in current American floras which record it as an introduction. Finding it in abundance at several localities in eastern Texas in May and June of 1968 led me to check the treatment in Flora Europaea vol. 1: 186—188 (1964), and the paper cited there, "A Revision of the Genus Petrorhagia" by P. W. Ball and V. H. Heywood, Bull. British Mus. (Nat. Hist.) Bot. 3 (no. 4): 121—172 (1964). Fernald (in Gray's Man. 8th ed. p. 636, 1950) calls the plant *Dianthus prolifer* L., and reports it as "local, s. N.Y. to Del., Va., Ky. and O." Gleason (in the New Britton & Brown Ill. Fl. 2: 145, 1952) calls it *Tunica prolifera* (L.) Scop., and reports it as "sparingly established in waste places, N.Y. to S.C. and Cal." Small does not mention it in either his Flora of the Southeastern United States (1903 and 1913) or his Manual of the Southeastern Flora (1933). Ball and Heywood note that as originally published by Ludwig and as chiefly used by Scopoli, *Tunica* was an illegitimate substitute name for *Dianthus* L., and the correct generic name for those species to which *Tunica* was later restricted is *Petrorhagia* (Ser.) Link. They make the required new combination *Petrorhagia prolifera* (L.) P. W. Ball & Heywood (l.c. p. 161). I saw this species for the first time in May, 1968, when it was present in great abundance along highways in several east Texas counties, roads which I had traveled almost yearly for two decades without finding it. In all cases it was associated with rye grass, *Lolium perenne* L. var. *italicum* (A. Braun) Parnell, probably planted by the state highway department. This may have provided a vehicle for introduction, and explain the sudden appearance in such abundance. The plants mostly had simple stems (as described by Heywood and Ball, not branched, as Gleason says). The petals were very small, lavender-rose. There were specimens in the SMU Herbarium from Arkansas, California, New Jersey, and Virginia (also from Austria, Czechoslovakia, Germany, Hungary, Italy, Portugal, Spain, Sweden, and Switzerland). Those from the first named state and from Texas are noteworthy range extensions from the area reported in Gray's Manual. ARKANSAS. FULTON CO.: glade, 16 mi. S. Mammoth Springs, 5 mi. N. Agnes, *D. M. Moore 510616*, 20 July 1950. Beside U.S. 63 at Trace Creek, se of Mammoth Springs, *R. Dale Thomas 10046*, 4 July 1968. TEXAS. MORRIS CO.: in southwestern Daingerfield, 21 April 1969, *Shinners 32,597*. RUSK CO.: 4.2 miles northwest of Tatum, *Shinners 32,222*, 5 May 1968; 3.8 miles northwest of Tatum, *Shinners, 32,595*, 20 April 1969. SMITH CO.: 3 miles southwest of Winona, *Shinners 32,602*, 21 April 1969. UPSHUR CO.: 5.8 miles east-southeast of Big Sandy, *Shinners 32,233*, 7 May 1968; 11 miles west of Gilmer, *Shinners 32,299*, 12 June 1968. VAN ZANDT CO.: 2.8 miles east of Grand Saline, *Shinners 32,238*, 7 May 1968. All the Texas collections were from sandy or sandy clay road shoulders.— *Lloyd H. Shinners*.

CHAMAESYCE JEJUNA (JOHNSTON & WARNOCK) SHINNERS, COMB. NOV. (EUPHORBIACEAE).—Based on *Euphorbia jejuna Johnston & Warnock,* Southw. Nat. 5 (2): 97—99. 1960. In the legend for the accompanying plate on p. 98 the authors are given as "Warnock & Johnston" but the authors for the article are named in alphabetical order as Marshall C. Johnston and Barton H. Warnock.—*Lloyd H. Shinners*

STYLISMA PATENS VAR. ANGUSTIFOLIA (NASH) SHINNERS, COMB. NOV. (CONVOLVULACEAE).—Based on *Breweria angustifolia* Nash, Bull. Torr. Bot. Club 22: 155. 1895. *Bonamia patens* var. *angustifolia* (Nash) Shinners, Castanea 27: 75. 1962. *Stylisma patens* (Desr.) Myint subsp. *angustifolia* (Nash) Myint, Brittonia 18: 112. 1966.—*Lloyd H. Shinners.*

CRYPTANTHA JAMESII VAR. SETOSA (M. E. JONES) SHINNERS, COMB. NOV. (BORAGINACEAE).—Based on *Krynitzkia multicaulis* var. *setosa* M. E. Jones, Contrib. West. Bot. 13: 4—5. 1910. *C. Jamesii setosa* (M. E. Jones) I. M. Johnston ex Tidestrom, Proc. Biol. Soc. Washington 48: 42. 1935. (This was one of 10 undesignated trinomials included by Tidestrom in a list of new Arizona plant names, with footnote on p. 39 by Frederick V. Coville. At that date, government botanists followed the American Code, under which all trinomials were subspecies, without explicit designation. In Tidestrom and Kittell's *A Flora of Arizona and New Mexico* (1941, p. 571) this particular trinomial is not listed even as synonym, and it was never adopted by I. M. Johnston.) *Krynitzkia multicaulis* var. *setosa* was cited as synonym under *Cryptantha Jamesii* var. *multicaulis* (Torr.) Payson, n. comb., by Payson in his monograph of sect. *Oreocarya* of the genus *Cryptantha* (Ann. Mo. Bot. Gard. 14: 244, 1927). It is older in varietal rank than either *multicaulis* or *Oreocarya multicaulis* var. *laxa* Macbride, Contrib. Gray Herb. 48: 35, 1916 (*Cryptantha Jamesii* var. *laxa* (Macbride) Payson, l.c. 246). It is not listed by I. M. Johnston in his recent treatment of the Boraginaceae of Texas (in Lundell, Fl. Texas vol. 1 pt. 2: 185, 1964). If vars. *multicaulis* and *laxa* are inseparable, as Johnston indicates (indeed Macbride in the original description of var. *laxa* says it is "an ecological variety," citing only one collection), then the above new combination is necessary under the present nomenclatural Code. It is published here in order to make it available for the forthcoming manual of Texas vascular plants by Drs. Donovan S. Correll and Marshall C. Johnston.—*Lloyd H. Shinners.*

CONOPHOLIS ALPINA LIEBMANN VAR. MEXICANA (GRAY EX WATSON) HAYNES, COMB. NOV. (OROBANCHACEAE).—Based on *C. mexicana* Gray ex Watson, Proc. Amer. Acad. Arts & Sci. 18: 131. 1883. This new combination is needed for an account of Texan Orobanchaceae being prepared for the *Flora of Texas.—Robert R. Haynes, Department of Biology, University of Southwestern Louisiana, Lafayette, La. 70501.*

HETEROTHECA ASPERA (SHUTTLEWORTH) SHINNERS, COMB. NOV. (COMPOSITAE).—Based on *Chrysopsis aspera* Shuttleworth ex Small, Fl. S.E. U.S. 1182. 1903. (Name used earlier on distribution labels sent out with Rugel specimens by Shuttleworth, and in synonymy under *C. graminifolia* var. *aspera* by Asa Gray, Syn. Fl. N.A. 1 pt.2: 121. 1878.) *Chrysopsis graminifolia* of Fernald, Rhodora 44: 468. 1942. Not of (Michx.) Ell. I am indebted to Drs. Marshall C. Johnston and Alicia Lourteig for the information that the type of *Inula graminifolia* Michx. is not the strongly glandular plant which Fernald assumed it to be, but has only some glandulosity on the apical portion of the phyllaries, placing it with the species which Fernald designated *Chrysopsis nervosa*.—*Lloyd H. Shinners.*

CROPTILON DIVARICATUM VAR. GRANITICUM (E. B. SMITH) SHINNERS, COMB. NOV. (COMPOSITAE).—Based on *Haplopappus validus* subsp. *graniticus* E. B. Smith, Rhodora 67: 236. 1965. I do not agree with Smith's treatment of the genus *Croptilon* as a section of *Haplopappus* with three species and two subspecies.—*Lloyd H. Shinners.*

HELEASTRUM CHAPMANII (T. & G.) SHINNERS, COMB. NOV. (COMPOSITAE).—Based on *Aster Chapmanii* T. & G., Fl. N.A. 2: 161. 1841. The caudex, grass-like leaf blades, corymbiform inflorescence, large heads, and coarse, stiff pappus bristles all show close relationship with the *Heleastrum* group rather than with *Aster tenuifolius* L., near which it has long been placed. It is, as Torrey and Gray said in describing it, "A very remarkable species."—*Lloyd H. Shinners.*

A NEW VARIETY AND NEW COMBINATION IN MELAMPODIUM (COMPOSITAE-HELIANTHEAE).—In preparing a treatment of *Melampodium* for the *Manual of Vascular Plants of Texas* (Correll & Johnston, in press) I recognized and included a new variety of *M. cinereum*. Since the manual contains no Latin diagnoses or descriptions, this new taxon is validly described below.

MELAMPODIUM CINEREUM DC. var. **hirtellum** var. nov. TYPE: MEXICO: Nuevo Leon, 5 km S of Sabinas Hidalgo on rd to Monterrey, 21 Apr 1939, *T. C. & E. M. Frye 2415* (Holotype, US!; isotypes, DS! GH! NY! RSA! UC!).

Caules strigoso-hispidi pilis 0.2-1.5 mm longis. Margines foliorum basi hispidi pilis 0.6-1.5 mm longis.

Distribution: Mesquite-grasslands in Coahuila, Nuevo Leon and northwestern Tamaulipas, Mexico and into Val Verde, Kinney, Uvalde and Maverick Cos. of Texas, 700-1700 ft. Principal flowering dates, Feb.-Oct.

A new combination is also recognized at this time. The taxon under consideration is somewhat intermediate between *M. leucanthum* and *M. cinereum* but is most similar in total morphology to the former species.

MELAMPODIUM LEUCANTHUM Torr. & A. Gray var. **argophyllum** (A. Gray ex Rob.) comb. nov.

Melampodium cinereum DC. var. *argophyllum* A. Gray ex Rob. Proc. Amer. Acad. Arts & Sci. 36:458. 1901. (A. Gray in Wats. Proc. Amer. Acad. Arts & Sci. 18:104. 1883. Without description, but type designated.)

Melampodium argophyllum (A. Gray ex Rob.) Blake, Contrib. U. S. Nat. Herb. 22: 606. 1924.

Further information on the above taxa will be included in a forthcoming revision of the genus (Stuessy, in preparation).—*Tod F. Stuessy, Academic Faculty of Organismic and Developmental Biology and The Herbarium, The Ohio State University, Columbus, Ohio 43210.*

DOCUMENTED PLANT CHROMOSOME NUMBERS 1969:1[a]

JAMES S. PRINGLE

Royal Botanical Gardens, Hamilton, Ontario, Canada

Figures 1 - 9 are tracings from photomicrographs. Figures 1 and 3, meiosis, microsporocytes; Figure 2A, mitosis, microgametophyte; Figures 2B, 4, and 8, mitosis, archemicrosporia; Figure 5, mitosis, cell from inner wall of young carpel; Figures 6, 7, and 9, mitosis, root tip cells.

POTAMOGETONACEAE

POTAMOGETON GRAMINEUS L.[b] (Fig. 1.) n = 26. Mich., Cheboygan Co.: *Pringle 791* (HAM).

RANUNCULACEAE

CLEMATIS HERACLE FOLIA DC. var. DAVIDIANA (Decne. ex Verlot) Hemsl.[c] (Fig. 6.) 2n = 16. Cult.: *Pringle 756* (HAM).

CLEMATIS MACROPETALA Ledeb. cv. MARKHAM'S PINK.[c] (Fig. 7.) 2n = 16. Cult.: *Pringle 793* (HAM).

CLEMATIS STANS Sieb. & Zucc.[b] (*C. kousabotan* Decne.) (Fig. 8.) 2n = 16. Cult.: *Pringle 863* (HAM, KSC).

CLEMATIS VIRGINIANA L.[b] (Fig. 9.) 2n = 16. Ont., Wentworth Co.: *Pringle 868* (pistillate, illustrated) and *757* (staminate) (HAM).

CRUCIFERAE

THLASPI ARVENSE L.[b] (Figs. 2A and 2B.) n = 7, 2n = 14. Ont., Wentworth Co.: *Pringle 797* (HAM).

SAXIFRAGACEAE

HEUCHERA CYLINDRICA Dougl.[c] (Fig. 3.) n = 7. B.C.: *Pringle 792* (HAM). If one desires to recognize varieties within this species, this plant combines traits of var. *cylindrica* and var. *glabella* (T. & G.) Wheelock.

GENTIANACEAE

GENTIANA LINEARIS Froel., s. str.[b] (Fig. 4.) 2n = 26. Ont., Nipissing Dist.: *Pringle 800* (HAM).

GENTIANA RUBRICAULIS Schwein.[c] (Fig. 5.) 2n = 26. Ont., Grey Co.: *Pringle 866* (HAM).

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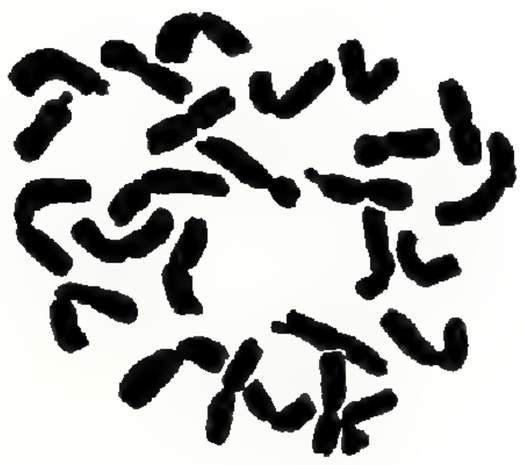
[a] Contribution No. 7 from the Royal Botanical Gardens, Hamilton, Ontario.
[b] Taxa for which similar chromosome counts have been published previously.
[c] Taxa for which no chromosome counts have been published previously.

SIDA 3 (5): 350—351. 1969.

1

A 2 B

3



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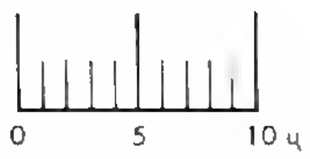

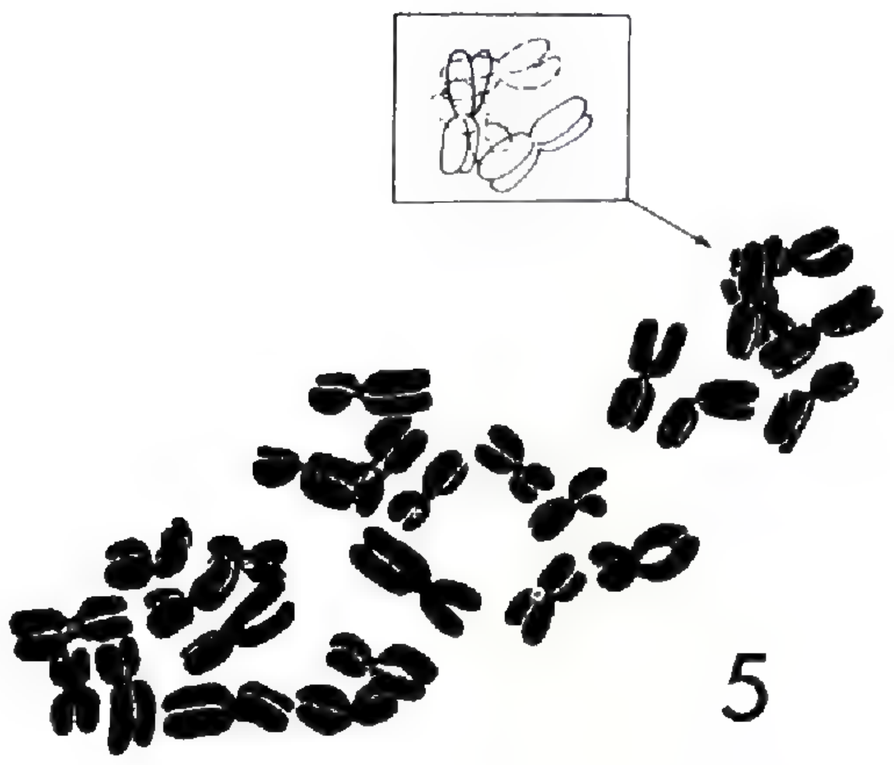

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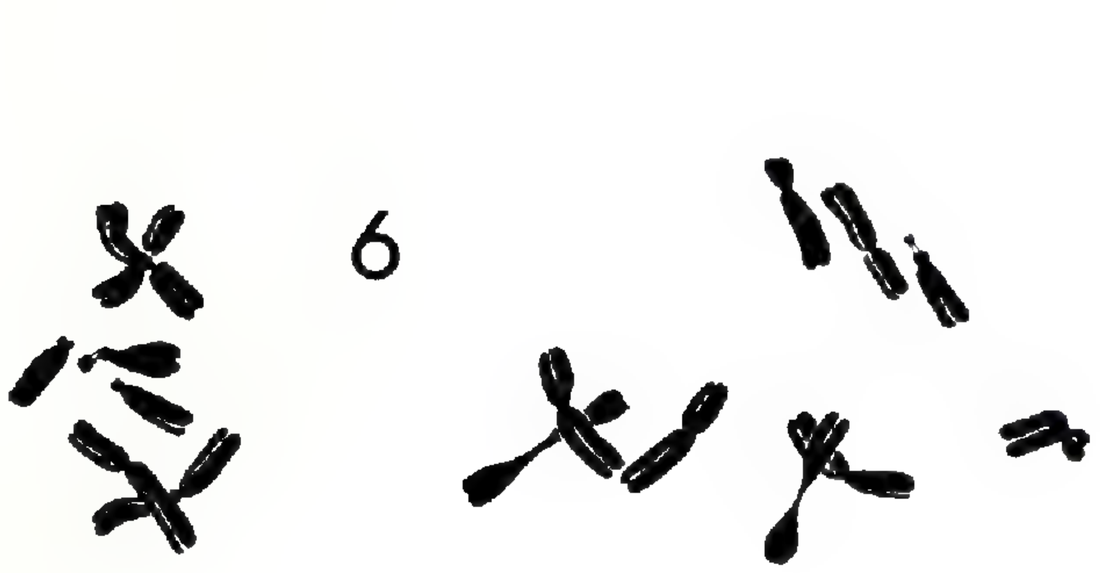

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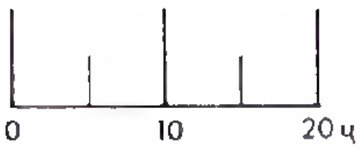

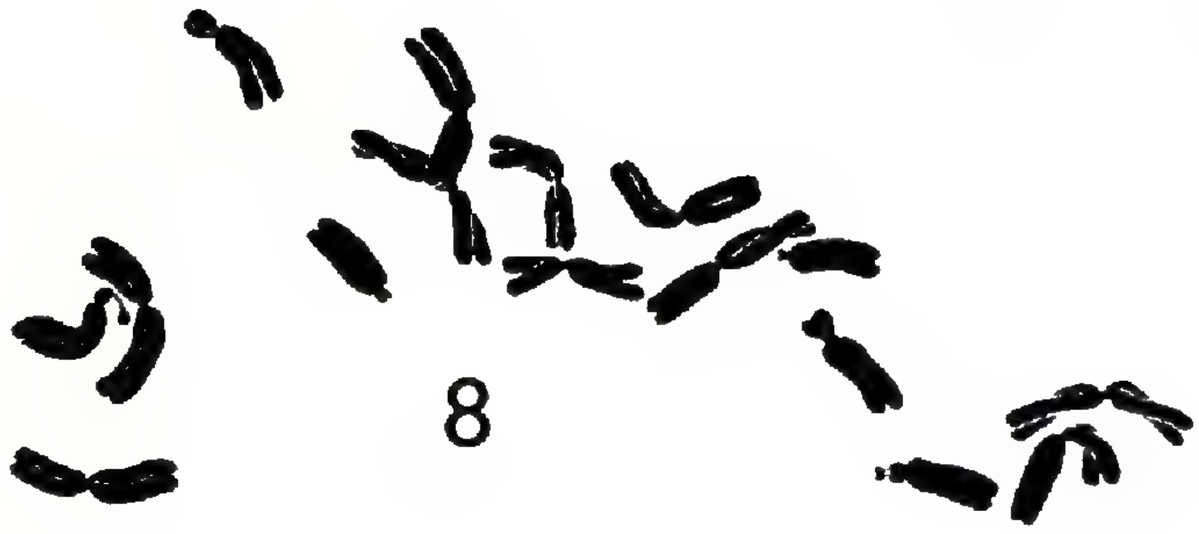

8

9

DOCUMENTED PLANT CHROMOSOME NUMBERS 1969:2

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The plant collections and cytological preparations reported here were made in conjunction with research sponsored by NSF grants GB-2313 and GB-5233X.

CACTACEAE

EPIPHYLLUM PHYLLANTHUS VAR. PITTIERI (Web.) Kimnach.[b] (Fig. 1, X 1824). Anaphase I, n = 11. Costa Rica, Cartago Prov.: *Conde 2* (DUKE); identified by M. Kimnach.

CHLORANTHACEAE

HEDYOSMUM CALLOSOSERRATUM Oersted.[b] (Fig. 2, X 2162). Diakinesis, n = 8. Costa Rica, San Jose Prov.: *R. L. Wilbur 8845* (DUKE); identified by C. E. Wood, Jr.

JUGLANDACEAE

ALFAROA COSTARICENSIS Standley.[c] (Fig. 3, X 2500). Metaphase II, n = 16. Guatemala, Quetzaltenango Dept.: *Stone 2210* (DUKE).

CARYA OVATA (Mill.) K. Koch.[a] (Fig. 4, X 2500). Anaphase I, n = 16. N.C., Durham Co.: Stone 1863 (DUKE).

HIPPOCASTANACEAE

BILLIA HIPPOCASTANUM Peyritsch.[c] (Fig. 5, X 3000). Mitotic metaphase, 2n = 40 (average chromosome length c. 1 μ). Costa Rica, Alajuela Prov.: *R. L. Wilbur* and *D. E. Stone 8669A* (DUKE).

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[a] Species for which a similar chromosome count has been published previously.
[b] No chromosome numbers reported previously for this species.
[c] No chromosome numbers reported previously for this genus.

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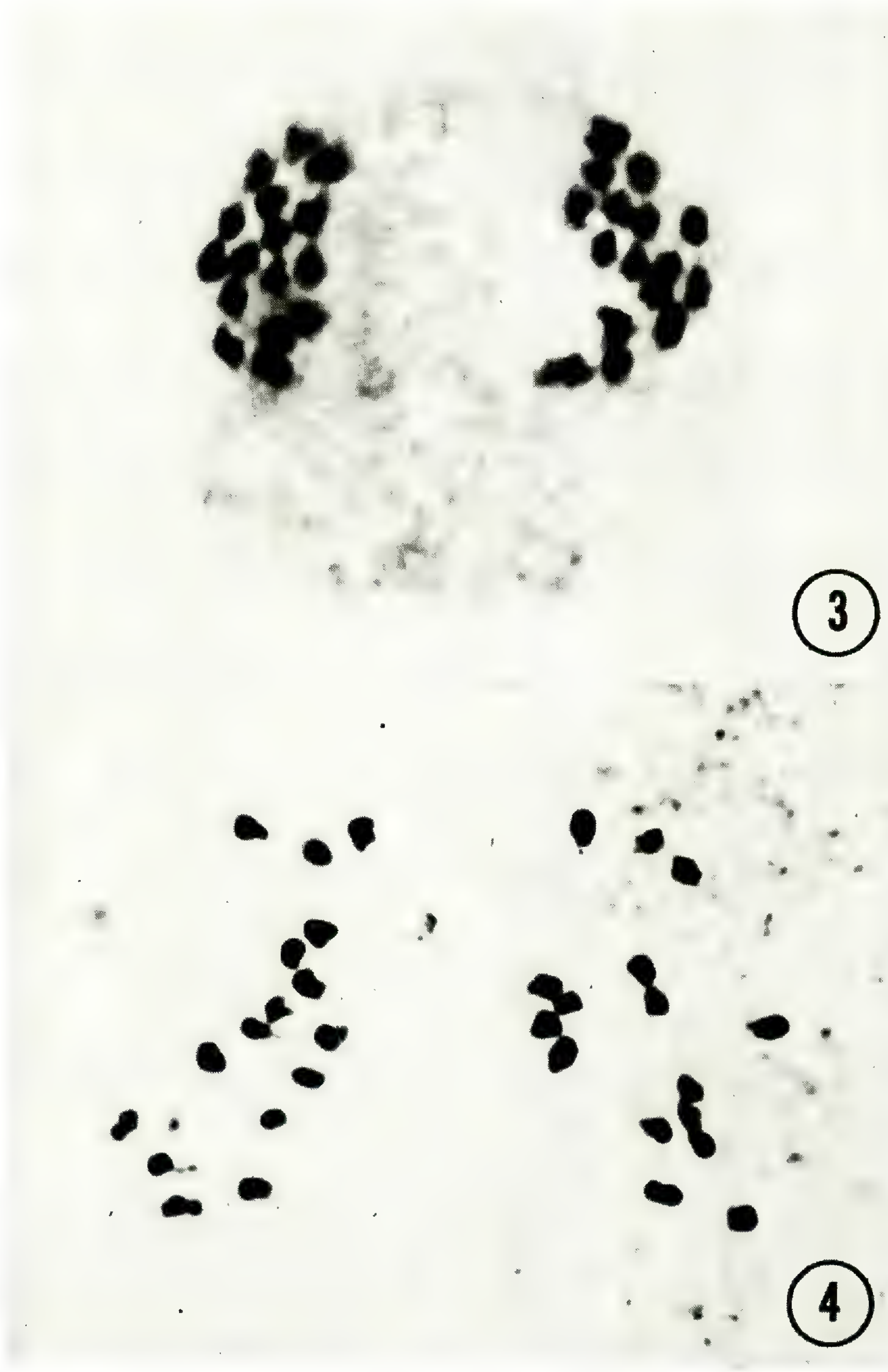
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DOCUMENTED PLANT CHROMOSOME NUMBERS 1969:3

L. J. HARMS
Department of Botany, North Dakota State University, Fargo[1]

Meiotic preparations from collections numbered *1600+* were made by Dr. R. C. Jackson of The University of Kansas. Collections referred to as McGregor, Harms, et al. include A. J. Robinson, R. del Rosario, and Ronald Segal. I express my thanks to Dr. John H. Beaman of Michigan State University for his determinations of many of the taxa. All figures traced from photographs - *1750×*.

ASTERACEAE (COMPOSITAE)

AMBLYOLEPIS SETIGERA DC. (Fig. 1.) n = 18. Texas, Zavala Co.: *R. L. McGregor 16777* (KANU, MSC). Differs from a previous report of n = 19.

ERIGERON DELPHINIFOLIUS ssp. NEOMEXICANUS (A. Gray) Cronq. (Fig. 2.) n = 18. Mexico, San Luis Potosi: *R. L. McGregor 16649* (KANU). Several previous reports of *n* = 9 for this, and all infraspecific taxa.

HELENIUM MEXICANUM HBK. (Fig. 3.) n = 14. Mexico, Nuevo Leon: *McGregor, Harms, et al. 491* (KANU, MSC). First report and in agreement with chromosome pattern established for the genus.

HELIANTHELLA MEXICANA var. LATIFOLIA Weber. (Fig. 4.) n = 15 (A_1). Mexico, Nuevo Leon: *McGregor, Harms, et al. 376* (KANU, MSC). First report and in agreement with chromosome pattern established for the genus.

HIERACIUM ABSCISSUM Less. (Fig. 5.) n = 9. Mexico, Michoacan: *McGregor 16584* (KANU). First report and in agreement with chromosome pattern established for the genus.

HYMENOXYS LINEARIFOLIA Hook. (Fig. 6.) n = 15 + supernumerary. Mexico, Nuevo Leon: *McGregor 16727.* (KANU, MSC). First report of occurrence of supernumerary chromosomes.

PSEUDELEPHANTOPUS SPICATUS (Juss.) Rohr. (Fig. 7.) n = 10. Mexico, Vera Cruz: *McGregor 16477* (KANU). First report of this monotypic genus and differing from n = 11 of *Eleophantopus* in which it was originally placed.

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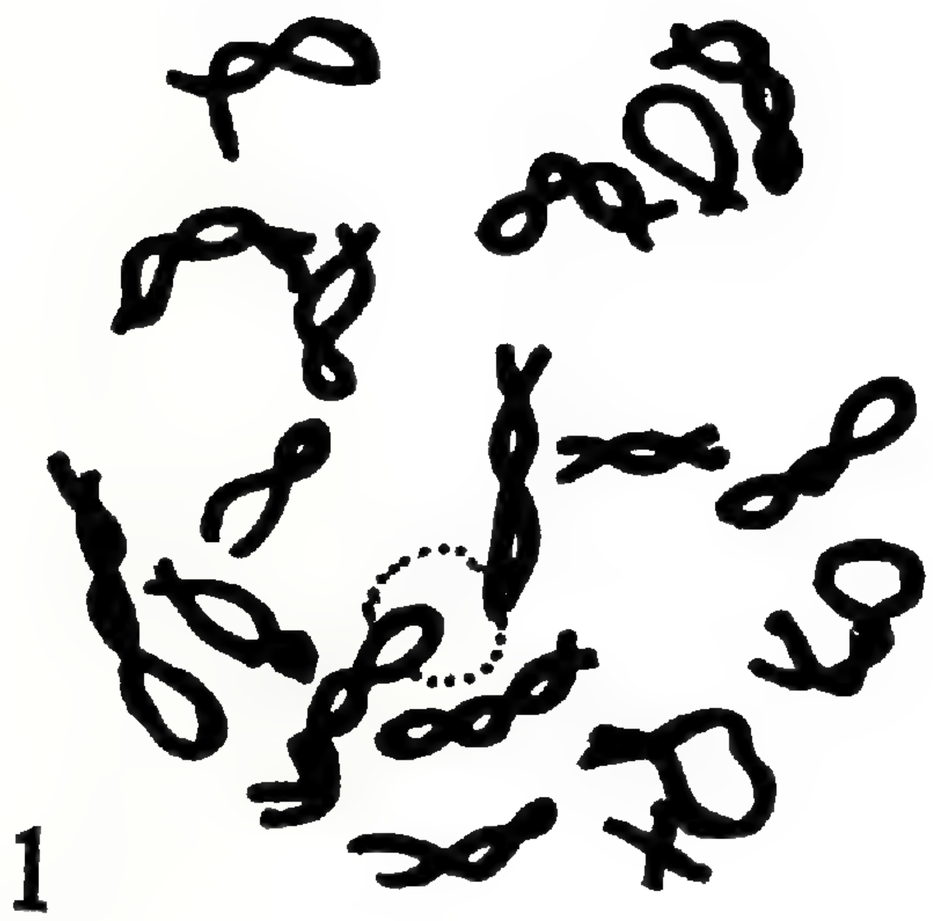
[1] New address: Systematic and Environmental Biology, Biological Sciences Group, University of Connecticut, Storrs, Connecticut 06268.



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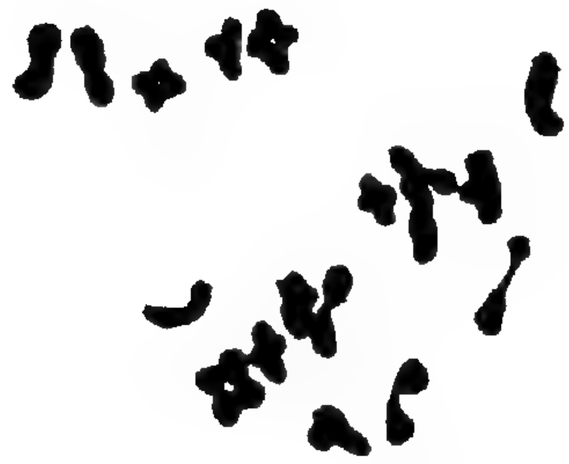

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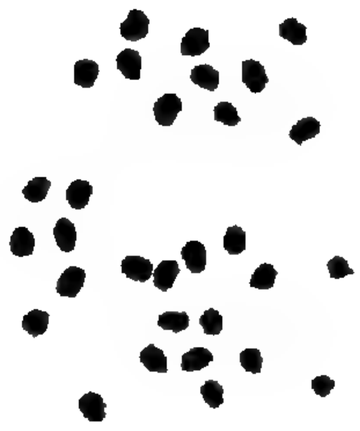

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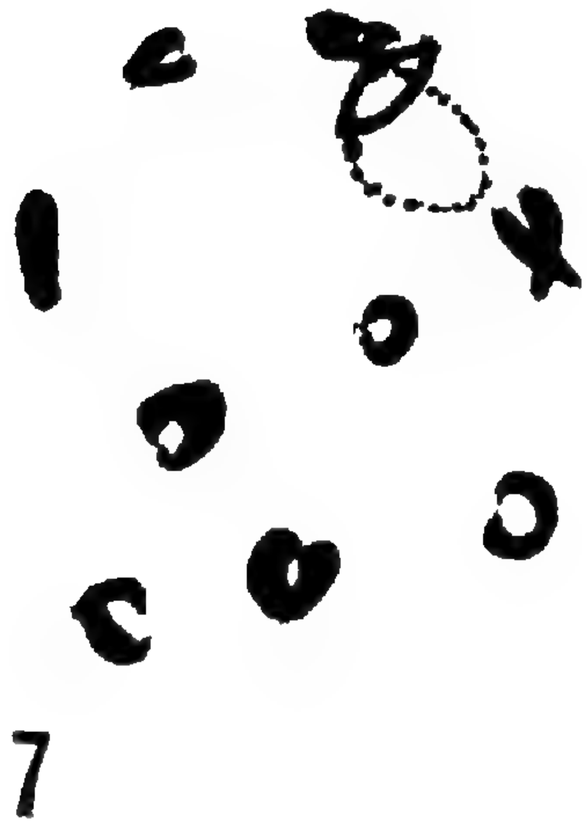

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THE PTERIDOPHYTES OF MISSISSIPPI

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University of Georgia, Athens, University of Mississippi, Oxford and Mississippi State University, State College

In the past several years there has been a resurgence of interest in plant taxonomy and of botanical collecting in Mississippi. A number of botanists have made contributions which have increased our knowledge of the flora. In 1966 and 1967, the National Science Foundation supported our field work, and we were able to cover many areas of the state seldom visited by botanists. We have made approximately 40,000 collections of vascular plants, most of which have been identified. The objectives of this paper are to stimulate interest in the ferns and fern allies, to encourage collecting within the state in order to improve the known distributions, and to summarize our present information on the ferns and fern allies. We would like to thank all who have helped with this project and especially Dr. W. H. Wagner for his assistance and encouragement.

The flowering plants and ferns of Mississippi were listed by Lowe (1921). His list, although valuable, is both incomplete and sometimes inaccurate. For example, species were included from the lists of other authors without checking the specimens.

In this list, the species are based on specimens examined from GA, MISSA, and the University of Mississippi. Several species are listed by Wherry (1964) or Lowe (1921) as occurring in the state or as having a range which includes Mississippi, and these species should be looked for in our area. Some of these are: *Adiantum hispidulum* Swartz; *Dryopteris marginalis* Gray; *Lecanium membranaceum* Presl; *Isoetes melanopoda* Gay & Durieu; *Lycopodium cernuum* L.; *Marsilea mucronata* Braun; *M. uncinata* Braun; *Ophioglossum petiolatum* Hooker; *O. tenerum* Mettenius; *Psilotum nudum* Grisebach; *Pteris vittata* L.; *Selaginella arenicola* Underwood ssp. *acanthonota* Tryon; *Trichomanes radicans* Swartz.

Mississsippi provides considerable diversity in climate, elevation, parent materials, and soils. Elevations range from around 800 feet above sea level in the extreme northeastern part to only a few feet above sea level along the Gulf Coast. The state is over 300 miles long in the north-south direction. This change in latitude, combined with the effects of the warm Gulf, causes climatic differences. In the extreme northeastern part of the state, one finds the southern flank of the Appalachian fold with limestones, shales and cherts of the carboniferous formation. The remainder of Mississippi is in the Gulf Coastal Plain with belts of varying parent materials or deposited soils. The physiographic regions of the state are shown in Fig. 1 and are based on those of Lowe (1921). They are: 1, Tennessee River Hills, TRH; 2, Northeastern Prairie Belt, NPB; 3, Pontotoc Ridge, PR; 4, Flatwoods, FW; 5,

SIDA 3 (6): 359—364. 1969.

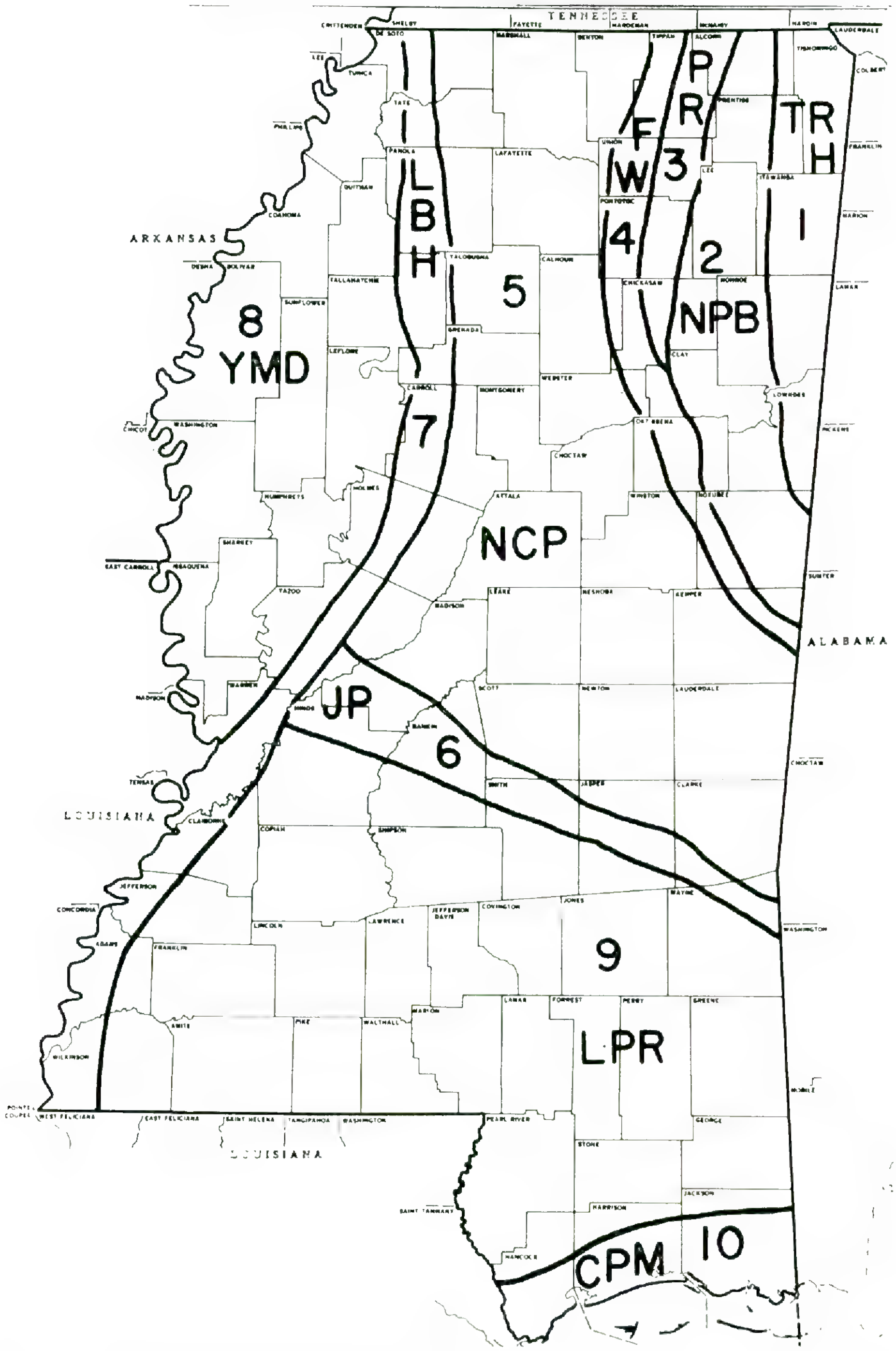

Fig. 1. The physiographic regions of Mississippi. 1, Tennessee River Hills, TRH; 2, Northeastern Prairie Belt, NPB; 3, Pontotoc Ridge, PR; 4, Flatwoods, FW; 5, North Central Plateau, NCP; 6, Jackson Prairie, JP; 7, Loess Bluff Hills, LBH; 8, Yazoo-Mississippi Delta, YMD; 9, Longleaf Pine Region, LPR; 10, Coastal Pine Meadows, CPM. The base map was used with permission of Rand McNally and Company. The regions are based on those of Lowe (1921).

North Central Plateau, NCP; 6, Jackson Prairie, JP; 7, Loess Bluff Hills, LBH; 8, Yazoo-Mississippi Delta, YMD; 9, Longleaf Pine Region, LPR; 10, Coastal Pine Meadows, CPM. The alluvial YMD is practically void of ferns. The greatest diversity of species is in the TRH in Tishomingo County. Distributional records indicate a need for additional field work in the middle one-third of the state. It is hoped that additions to the fern flora or new distributional records will be brought to our attention.

ALPHABETICAL LIST OF TAXA WITH DISTRIBUTIONS BY REGIONS AND COUNTIES:

Adiantum capillus-veneris L.
JP; Clarke, Wayne.

Adiantum pedatum L.
TRH, PR, NCP, LBH; Adams, Carroll, Chickasaw, Grenada, Holmes, Jefferson, Lafayette, Madison, Monroe, Pontotoc, Tallahatchie, Tate, Tishomingo, Warren, Wilkinson.

Anchistea virginica (L.) Presl
LPR, NCP, CPM; Forrest, Harrison, Jackson, Lamar, Lauderdale, Newton, Pearl River, Wayne.

Asplenium pinnatifidum Nutt.
TRH; Tishomingo.

Asplenium platyneuron (L.) Oakes ex D.C. Eaton
Throughout except YMD; Amite, Attala, Benton, Carroll, Chickasaw, Claiborne, Clarke, George, Grenada, Hinds, Holmes, Jackson, Jefferson, Jefferson Davis, Lafayette, Lauderdale, Lawrence, Lee, Lincoln, Marion, Marshall, Monroe, Montgomery, Noxubee, Panola, Perry, Pike, Tate, Tishomingo, Union, Warren, Wilkinson, Yalobusha, Yazoo.

Asplenium trichomanes L.
TRH; Tishomingo.

Athyrium asplenioides (Michx.) A. Eaton
Throughout except YMD; Attala, Benton, Calhoun, Clarke, Copiah, Covington, Forrest, Franklin, George, Holmes, Jackson, Jefferson Davis, Jones, Lafayette, Lamar, Lee, Lincoln, Madison, Marion, Marshall, Monroe, Oktibbeha, Panola, Perry, Pike, Pontotoc, Prentiss, Simpson, Smith, Stone, Walthall, Wayne, Winston.

Athyrium pycnocarpon Tidestrom
TRH; Tishomingo.

Azolla caroliniana Willd.
YMD, NPB, LPR; Bolivar, Noxubee, Pearl River.

Botrychium alabamense Maxon
LPR; George.

Botrychium biternatum (Sav.) Underwood
Scattered throughout except YMD; Covington, Jefferson Davis, Lafayette, Noxubee, Panola, Pike, Scott, Smith, Tishomingo.

Botrychium dissectum Spreng.
NCP, LPR; Franklin, Lafayette, Marshall.

Botrychium virginianum (L.) Swartz
Scattered throughout except YMD; Alcorn, Benton, Calhoun, Carroll, Chickasaw, DeSoto, Forrest, Hinds, Lafayette, Lee, Monroe, Oktibbeha, Panola, Tate, Tippah, Tishomingo, Union, Warren, Wilkinson, Winston, Yalobusha.

Camptosorus rhizophyllus (L.) Link
TRH, PR; Tishomingo, Union.

Cheilanthes lanosa (Michx.) D.C. Eaton
TRH, NCP; Lafayette, Tishomingo.

Cystopteris protrusa (Weath.) Blasdell
LBH; Adams, Jefferson, Tate, Warren, Wilkinson.

Equisetum hyemale L. var. *elatum* Morton
Scattered throughout; Adams, Carroll, Clarke, Holmes, Tunica, Union.

Lorinseria areolata (L.) Presl
Throughout except YMD, LBH; Attala, Calhoun, Choctaw, Clarke, Covington, Franklin, George, Harrison, Jackson, Jones, Lafayette, Lamar, Lauderdale, Lincoln, Marion, Marshall, Noxubee, Oktibbeha, Pearl River, Pike, Smith, Stone, Tishomingo, Walthall.

Lycopodium appressum (Chapm.) Lloyd & Underwood
LPR, CPM, NCP; Forrest, Greene, Hancock, Lauderdale, Pearl River, Smith.

Lycopodium alopecuroides L.
LPR, CPM, NCP; George, Hancock, Harrison, Jackson, Lauderdale, Marion, Pearl River, Smith, Stone.

Lycopodium carolinianum L.
LPR, CPM; Greene, Stone.

Lycopodium prostratum Harper
LPR, CPM; Forrest, Hancock, Lamar, Pearl River, Perry, Stone.

Lygodium japonicum (Thunb.) Swartz
LPR, CPM, NCP, scattered in the southern one-third of the state; Amite, George, Jackson, Jefferson Davis, Lauderdale, Marion, Pearl River, Perry, Pike, Smith, Stone.

Onoclea sensibilis L.
Throughout except YMD; Adams, Amite, Carroll, Copiah, Holmes, Lafayette, Lamar, Lauderdale, Lawrence, Marion, Marshall, Monroe, Noxubee, Perry, Pike, Simpson, Stone, Tate, Tishomingo, Wilkinson.

Ophioglossum crotalophoroides Walt.
NCP; Lafayette.

Ophioglossum engelmannii Prantl
NCP; Lafayette, Madison.

Ophioglossum vulgatum L. var. *pycnostichum* Fern.
Scattered, NCP, TRH, LPR, YMD; Lafayette, Leflore, Marion, Monroe, Tate.

Osmunda cinnamomea L.
LPR, CPM, PR, TRH, NCP; Calhoun, Forrest, George, Greene, Harrison,

Jackson, Jasper, Jefferson Davis, Lamar, Lauderdale, Lee, Marion, Monroe, Oktibbeha, Pearl River, Perry, Stone, Tippah, Walthall.

Osmunda regalis L. var. *spectabilis* (Willd.) Gray
LPR, CPM, NCP, PR, NPB; Calhoun, Clarke, Covington, Forrest, Franklin, George, Greene, Jackson, Jefferson Davis, Jones, Lafayette, Lamar, Lauderdale, Lee, Marion, Monroe, Pearl River, Perry, Pike, Prentiss, Scott, Stone, Tippah, Wayne.

Polypodium polypodioides (L.) Watt
Throughout except YMD; Attala, Benton, Carroll, Clarke, Greene, Jackson, Jefferson, Jones, Lafayette, Lauderdale, Lawrence, Lincoln, Marion, Marshall, Monroe, Montgomery, Noxubee, Oktibbeha, Panola, Perry, Smith, Stone, Tippah, Tishomingo, Union, Webster, Yalobusha.

Polytichum acrostichoides (Michx.) Schott
Throughout except YMD; Adams, Amite, Alcorn, Benton, Carroll, Calhoun, Chickasaw, Claiborne, Clarke, Forrest, Franklin, Jackson, Jefferson, Jones, Lafayette, Lamar, Lauderdale, Lee, Marion, Monroe, Panola, Perry, Pike, Pontotoc, Scott, Smith, Stone, Tallahatchie, Tate, Tippah, Tishomingo, Union, Walthall, Wilkinson, Yalobusha.

Pteridium aquilinum (L.) Kuhn var. *pseudocaudatum* Heller
Throughout except YMD and TRH; Adams, Benton, Calhoun, Carroll, Choctaw, Claiborne, Clarke, Copiah, Covington, Forrest, Franklin, Greene, Hancock, Harrison, Jackson, Jasper, Jefferson Davis, Jones, Lafayette, Lamar, Lawrence, Marion, Monroe, Noxubee, Panola, Pearl River, Perry, Scott, Smith, Walthall, Wayne, Yalobusha.

Pteris multifida Poir.
LBH; Hinds, Jefferson, Warren, Wilkinson.

Selaginella apus (L.) Spring.
TRH, NCP, LPR; Forrest, George, Lafayette, Perry, Stone, Tishomingo.

Thelypteris dentata (Forsk.) C. Chr.
LPR, NCP, LBH; Adams, Amite, George, Jackson, Lauderdale, Stone.

Thelypteris hexagonoptera (Michx.) Weatherby
Scattered throughout except YMD, NPB, JP; Adams, Benton, Carroll, Claiborne, Forrest, George, Jackson, Lafayette, Lauderdale, Lawrence, Marshall, Monroe, Panola, Perry, Pontotoc, Prentiss, Stone, Tallahatchie, Tate, Tishomingo, Warren, Webster, Wilkinson.

Thelypteris normalis (Christens.) Moxley
Southern one-half of the state; Claiborne, Copiah, George, Hancock, Harrison, Hinds, Jackson, Jefferson, Jones, Marion, Pearl River, Perry, Pike, Warren, Wayne, Wilkinson, Winston.

Thelypteris noveboracensis (L.) Nieuwl.
TRH; Itawamba, Tishomingo.

Thelypteris palustris Schott
LPR, CPM; George, Jackson, Jefferson Davis, Lamar, Pearl River, Marion, Smith, Wayne.

Thelypteris torresiana (Gaud.) Alston
LPR; Amite, Covington, Marion, Smith.
Thelypteris × *versicolor* R.P. St. John
Scattered in the southwestern part of the state; Adams, Marion, Wilkinson.
Trichomanes petersii Gray
One locality in LPR; Simpson.
Woodsia obtusa (Spreng.) Torr.
Scattered in LBH, TRH, NCP; Amite, Benton, Copiah, Hinds, Jefferson, Lafayette, Lowndes, Madison, Tishomingo.

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LEGUMES OF THE UNITED STATES: I. NATIVE ACACIA[1]

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Ames, Iowa 50010

I have been concerned with a manual review of U.S.[2] legumes for several years. It is desirable that a partial accounting not be delayed until ultimate manual publication. Exposure of viewpoints to critical colleagues will facilitate the process of eliminating dross. Further, one needs to conduct nomenclatural transactions and present rationale for taxonomic decisions ere the manuscript is desiccated to manual format.

Opera prepared through the employment of classic taxonomic procedures (herbarium, field, library) do not solve all of the problems nor provide sophisticated evolutionary interpretations. Assuming such limitations, these treatments represent a stage in the improvement of knowledge and should facilitate the pathway of those following. And also, for the pragmatic present, it is hoped that interpretations are such that one can key a plant to a name.

These entries will include (1) keys: a summary view of delimitations, (2) distributional, habitat and phenological briefs, (3) nomenclatural reviews, and (4) taxonomic and nomenclatural commentary where pertinent. Publication of descriptions (except of genera and new taxa) and distributional maps is deferred.

With respect to nomenclature, I use the paragraph system for synonymy; names based on one type are included in one paragraph, and the "type-bearing" name is capitalized. An attempt has been made to account for all names based on U.S. types. However, the range of many of our species is largely outside of the United States (as most kinds of *Acacia*). Evaluation of tropical American as well as Old World binomials is largely limited to those of critical status.

Continued support from the Iowa Agricultural Experiment Station and the Sciences and Humanities Research Institute has rendered these investigations possible. I have used the facilities of a number of herbaria and have generously been accorded loans. Help and encouragement has been received from many individuals. I permit myself the luxury of mentioning two names: Rupert Barneby, long-standing friend and acroatic counselor; and John F. Reed, Head Curator of the New York Botanical Garden Library, and staff who have aided a sometimes confused bibliophile beyond the call of reason or duty.

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[1] Journal Paper No. J-6325 of the Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa. Project 1073. This research is funded by the National Science Foundation, Grant GB-7342.

[2] The conterminous United States (Kuchler, 1964); i.e. Hawaii and Alaska are excluded.

For this entry, native *Acacia*, I have used all U.S. mimosoid material from the following herbaria: New York Botanical Garden (NY), Iowa State University (ISC), University of Texas (TEX), New Mexico State University (NMC), University of Arizona (ARIZ), University of Southwestern Louisiana (LAF), Mississippi State University (MISSA), Florida State University (FSU), and University of South Florida (USF). Selected materials and/or types have been studied courtesy of the following: Southern Methodist University (SMU), Gray Herbarium (GH), Missouri Botanical Garden (MBG), Lundell Herbarium (LL), U.S. National Museum (US), and the Philadelphia Academy of Natural Sciences (PH). My debt to these institutions is obvious; warmest thanks are tendered to the herbarium curators.

ACACIA Mill.

Trees or shrubs, rarely herbs, often spiny. Leaves bipinnate, or (introduced Australian species) reduced to simple phyllodia. Pinnae 1—many pairs; leaflets often small and numerous. Petiole and/or rachis usually gland-bearing. Plants with paired stipular spines or internodal prickles, or unarmed; stipules if not spiny, small and deciduous. Flowers in heads or spikes (less frequently, racemose), usually yellow. Perianth regular, 2-ranked, (3) 4—5 merous. Calyx campanulate, the sepals free only apically in most species. Corolla gamopetalous. Stamens well exerted, numerous, free. Ovary sessile to stipitate. Legume various: usually oblong to linear, compressed to turgid, membranous to woody, straight to curved, sometimes irregularly constricted to moniliform, dehiscent or indehiscent. Funiculus often conspicuous (especially in introduced species), frequently encircling the seed, or terminally arillate. Seeds several.

Basic chromosome number x = 13; determinations on ca 60 species (Darlington and Wylie, 1956).

Acacia constitutes an immense genus of possibly 600 species, represented primarily in Australia, tropical Africa, and tropical America. In Australia, it constitutes the largest genus of flowering plants. Our representatives include both native and introduced species.

The acacias native to the United States are mostly northern outliers of Mexican and Caribbean species. They extend across the southern extremity of the country (*A. angustissima* as far north as southern Missouri) from Florida to California; the greatest number is in Texas. One of them, *A. smallii* (*A. farnesiana* auct.), is abundantly planted as an ornamental.

Britton and Rose (1928) dissected the American acacias into several fragment-genera (primarily on the basis of pod variance). Posterity has in general rejected their interpretation and I am inclined to this viewpoint.

Acacia Mill. Gard. Dict. Abridg. ed. 4 (vol. 1). 1754! Type species: *A. nilotica* (L.) Delisle.

There has been some inconsistency in author citation for *Acacia*. The primary reason (Isely, 1957) was lack of agreement among botanists as to the propriety of accepting the fourth edition of Miller's Gardener's Dictionary

(1754) as a source of generic names. The status of Miller generic names is now unequivocal (Dandy, 1967; Stafleu, 1967).

The problem of a lectotype species for *Acacia* is ostensibly moot. Britton and Rose (1928) cite *A. nilotica* (L.) Willd; Hutchinson (1964) designates *A. arabica* Willd., and Index Nominum Genericorum specifies *Mimosa scorpioides* L.

Assuming a broad circumscription of a polymorphic species, all the preceding binomials refer to the same taxon. I concur with Hill (1940) that the proper designation is *A. nilotica* (L.) Delisle.

No nomenclatural necessity urges a review of the typification of *Acacia*, and I have not attempted such. Hutchinson (1964) tabulates extensive synonymy.

KEY TO SPECIES[3]

1. Flowers in spikes.
   2. Pinnae (4)6—10 pairs; Arizona. . . . . *A. millefolia*
   2. Pinnae 1—3(4) pairs; Texas—California.
      3. Pinnae usually 1 pair; spines paired, nodal; southern to western Texas. . . . . *A. rigidula*
      3. Pinnae (1)2—3 pairs; spines internodal, not paired; Texas—California. . . . . *A. greggii*
1. Flowers in globose to slightly elongated heads.
   4. Spines present, nodal, paired, straight, usually conspicuous, sometimes reduced to prickly, acicular stipules.
      5. Pinnae (4)5—10(17) pairs; foliar glands petiolar and usually also between uppermost pinnae, frequently elongate or somewhat elevated; rachis conspicuously puberulent or villosulous; southernmost Florida.
         6. Pinnae (8)10—17 pairs; leaflets not reticulate; leaf rachis openly canaliculate; petiolar gland often raised, circular, cupuliform. . . . . *A. macracantha*
         6. Pinnae (4)5—8 pairs; leaflets plainly reticulate; leaf rachis narrowly cananiculate; petiolar gland sessile, often elongate. *A. tortuosa*
      5. Pinnae 1—5(7) pairs; foliar glands, rachis pubescence and ranges various.
         7. Leaflets linear, ca 1 mm wide, widely spaced on rachis and usually distinctly alternate; local, Brewster Co., Texas. . *A. schottii*
         7. Leaflets not linear; range various.
            8. Peduncles bracteate about the middle (if bracts are gone, a nodal bump is evident).
               9. Pinnae 1—2(3); petiole-rachis axis 0.3—1.5 cm long; leaflets ovate, thick and often conspicuously glutinous, 1—2(3) mm long. . . . . *A. neovernicosa*
               9. Pinnae (3) 4—6 pairs; leaflets ovate to short-oblong, neither conspicuously thick nor glutinous, (1.5) 2—3 (4.0) mm long. . . . . *A. constricta*

[3] These are treated in alphabetical order in the text.

8. Peduncles bractless or with bracts immediately subtending head.
10. Species of southern Florida only (infrequently eastern Florida to southernmost Georgia); leaflets evidently reticulate or leaves small (petiole-rachis usually not exceeding 3 cm in length; leaflets ca 2(3) mm long); glands petiolar; peduncles frequently 2—3 cm long.
11. Leaflets conspicuously reticulate beneath, 4—5(6) mm long; pod obtuse to acute, not beaked; stems not conspicuously zig-zag; thorns various. . . . . *A. farnesiana*
11. Leaflets not reticulate beneath, ca 2(3) mm long; pod sharply tapering or with a beak to 1 cm; stems zig-zag; thorns slender, usually about 1 cm long. . . . *A. pinetorum*
10. Species of western Florida Panhandle to California; plants not possessing above combinations of characters.
12. Pods stout, 3—6 cm long, scarcely constricted between seeds, glabrous, straight; foliar glands petiolar; leaflets scarcely reticulate beneath; peduncles largely 1.0—1.5(2.0) cm long, straight, stout, usually lacking reddish glands; western Florida to California. . . . . *A. smallii*
12. Pods slender, 8—15 cm long, irregularly moniliform; foliar glands located between lowermost or several pairs of pinnae; leaflets (when fully expanded) somewhat reticulate beneath; peduncles (1.3) 2.0—3.0 mm long, often curved, usually bearing tiny, deciduous gland-like structures; southern Texas only. . . . . *A. schaffneri*
4. Nodal spines not present; plants with internodal prickles or unarmed.
13. Plants unarmed, herbaceous or suffrutescent (locally suffrutescent-woody, Brewster Co., Texas and Cochise Co., Arizona); petiole-rachis eglandular; flowers conspicuously pedicellate. *A. angustissima*
13. Plants usually prickly, woody; petiole glandular; flowers scarcely pedicellate.
14. Pinnae 4—11 pairs; leaflets 15—35 pairs, 3—4 mm long; southern Texas west to Brewster Co. . . . . *A. berlandieri*
14. Pinnae 1—3 (4) pairs; leaflets 5—9 pairs, 4—9 mm long; central to western Texas. . . . . *A. roemeriana*

ACACIA ANGUSTISSIMA (Mill.) Ktze.

Southern United States: (Florida) Arkansas to Arizona, north to southern Missouri. Mexico and Central America. See varietal treatment.

Chromosome number 2n = 26 (Turner, 1959; as *A. texensis*).

Typical *Acacia angustissima* is a shrub or small tree of Mexico and Central America. It does not occur in the United States. My use of this binomial, rather than *A. hirta* for US forms, indicates that I am interpreting *A. angustissima* in a broad sense (likewise Woodson and Schery, 1950, and Standley and Steyermark, 1946). I have no firm convictions concerning the circumscription of *A. angustissima in toto*. On the basis of examination of numer-

ous *Acaciella* types of Britton and Rose I wonder if much of this genus might reasonably be placed within the confines of a single species, *A. angustissima*.

The delimitation of taxa within *A. angustissima* in the United States has previously been presented by Wiggins (1942), Benson (1943), Benson and Darrow (1944) and Turner (1959). These authors are not in accord. The problems relate both to the circumscription of *A. angustissima* and interpretation of subordinate taxa. My treatment more closely resembles that of Benson than those of the other authors.

KEY TO VARIETIES

1. Plants woody to suffrutescent; varieties (those of US) limited to western Texas and southern Arizona.
   2. Plants shrubs or small trees 2—5(10) m tall; pinnae to 20 pairs; leaflets without secondary venation; not found in United States. . . . . var *angustissima*
   2. Plants woody to suffrutescent 0.1—2.0(3) m tall; pinnae to 12 pairs.
      3. Robust plants of Huachuca Mts., Cochise Co., Arizona; leaflets with secondary nervation beneath; pinnae 9—10 pairs. . var *shrevei*
      3. Low, contorted form of Brewster Co., Texas; leaflets without secondary venation; pinnae (1) 2—4; some intermediacy with var *texensis* below. . . . . var *chisosiana*
1. Plants herbaceous to slightly suffrutescent; Florida to Arizona.
   4. Variety of Florida to western Texas; leaf petiole-rachis 6—10 cm long; pinnae 9—12 (15) pairs; leaflets 18—30 pairs; peduncles axillary and shorter than subtending leaves. . . . . var *hirta*
   4. Varieties of southern and western Texas to Arizona where overlapping in range with above; leaf petiole-rachis 2.5—7.0 cm long and pinnae or leaflets (or both) fewer than above (for intermediate material from Texas see *hirta*—(*texensis*) below).
      5. Varieties of western and southern Texas to eastern Arizona; inflorescences strictly axillary; leaves as follows.
         6. Petiole-rachises mostly (4) 5—7 cm long; pinnae 7—9 pairs; leaflets 12—20 pairs, western and southern Texas. . . . . var *hirta* (intergradient with *texensis*)
         6. Petiole-rachises mostly 2.5—4 cm long; pinnae (3) 4—6 pairs; leaflets 9—15 pairs; western Texas (rarely southern Texas), New Mexico and slightly into Arizona. . . . . var *texensis*
      5. Variety of central and southern Arizona; inflorescences usually terminally aggregated and exceeding leaves; petiole-rachises (4) 6—10 cm long; pinnae 6—9 (10) pairs; leaflets 15—25 pairs. var *suffrutescens*

Var ANGUSTISSIMA

Shrub or tree 2—5(10) m. Pinnae to 20 pairs. Heads often appearing in terminal panicles.

Mexico and Central America.

Var *angustissima* has been reported from Texas by Wiggins (1942), and I have seen specimens marked by him as var *typica*. I see no evidence that

they represent shrubby plants or that they are anything other than var *hirta*. Turner (1959) also excludes var *angustissima* from Texas.

Acacia angustissima (Mill.) Ktze. Rev. Gen. Pl. 3(2): 47. 1898! *Mimosa ANGUSTISSIMA* Mill. Gard. Dict. ed 8. Mimosa no. 19. 1768! Photo of type (BM) US! Houston, Vera Cruz, 1731. *Acaciella angustissima* (Mill.) Britt. & Rose N. Am. Fl. 28: 100. 1928!

Wiggins (1942) discusses the original material of *M. angustissima* Mill. Wiggins (1942) and Woodson and Schery (1950) present extra-US synonymy of *A. angustissima*.

Var. CHISOSIANA Isely

Low woody shrub. Leaves sparsely puberulent. Petiole-rachis length 0.8—2.0 (3.0) cm. Pinnae (1) 2—4 pairs. Leaflets 6—10 pairs. Heads with 4—8 (10) flowers.

Western Texas, Brewster, Presidio and El Paso Cos. Also Chihuahua and Coahuila. Grassy slopes north of Chisos Mts. and desert mountains; igneous soils at least in part. 3500—5000 ft(?). June—Aug.

I have not as yet seen this plant in the field. It is seemingly an intricately branched or contorted subshrub 2—4 dm high. It is ostensibly intergradient with var *texensis* (to which material has previously been referred). It is, in general, distinguishable from that taxon by its woody habit, pinnae, leaflets, and possibly flower number.

Acacia angustissima var. **chisosiana** var. nov.[4]

Suffrutices humiles 2—4 dm altae; foliorum pinnae (1) 2—4-jugae, foliola 6—10-juga; capitula 4—8-flora. Flores et legumina var. *texensis* similes. Type Warnock 20719. "Top of Divide (of Wilson) — Chisos Mts., July 27, 1937." (NY!)

Var. HIRTA (Nutt.) Robinson

Plants herbaceous to basally suffrutescent, ascending to decumbent; petiole-rachis (of upper leaves) (5)7—10 cm long; pinnae (7)9—12(15) pairs; leaflets (12)18—30 pairs. Leaflets not nerved beneath. Heads intercalary, rarely in a terminal raceme.

Texas to extreme southern Kansas and Missouri, northern Arkansas, Florida; Mexico. Eastern: open woodlands, glades, bluffs, limestone or shale, ledges and outcrops. Western: prairie grassland, roadsides, open woodlands, usually alkaline soils. May—July or (Florida) August—Sept.

This is the major phase of *A. angustissima* in the United States. It is sprawling, mildly suffrutescent, but the stems die back each year. I have usually seen it in grass in prairie remnants. In northern Arkansas, however, it is almost entirely limited to calcareous outcrops above streams, usually under shade.

My delimitation of *A. angustissima* var *hirta* circumscribes those forms of *A. angustissima* which range from Florida to western Texas where they blend into var *texensis*. This interpretation is at variance with that of Wiggins (1942), Benson (1943) and Benson and Darrow (1944) who extend var.

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[4] Latin transcriptions of diagnoses prepared by Rupert Barneby.

hirta into Arizona. Benson's treatment I find credible. After extracting var. *cuspidata* (var. *texensis* of the present treatment), he decided that the morphological differences between the Texas (var. *hirta*) and Arizona (my *suffrutescens*) forms did not warrant varietal segregation. I disagree for reasons given under treatment of the latter variety. Wiggins (1942) has *A. angustissima* var. *hirta*, subspecies *suffrutescens*, and *A. cuspidata* all roughly sympatric in Arizona; I am unable to interpret his treatment or satisfactorily apply it to material at hand.

Throughout most of its range, var. *hirta* possesses a petiole-rachis 6—10 cm long, (9) 10—12 (15) pairs of pinnae and 18—30 pairs of leaflets. But *hirta* blends with var. *texensis* at the western and southern extremities of its range; and one encounters numerous forms with smaller leaves, and fewer pinnae and leaflets. I have defined *texensis* in terms of its typical form (leaves 2.5—4 cm long with 3—6 pairs of pinnae); the intermediate forms I have associated with var. *hirta* as indicated in the key.

The status of Florida material referred to var. *hirta* is problematic. To my knowledge, these populations are disjunct by several hundred miles from the other forms of the species. Wiggins (1942) states that var. *hirta* occurs in scattered localities along the Gulf Coast from Texas to northern Florida, but he cites no such specimens and I have seen none. Possibly the apparent disjunction on the map may be due to a relative paucity of botanical collectors in Mississippi and Alabama. There seems no morphological differentiation except for the fact that most (but not all) of my rather limited Florida material represents the glabrate extreme of var. *hirta*.

Pubescence variance in this variety is conspicuous; the range is from hirsute-villous to inconspicuously puberulent. There is at least some regional patterning in the amount and kind of pubescence, but I have not studied it in detail.

Acacia angustissima var. *hirta* (Nutt.) Robinson Rhodora 10: 33. 1908! *Acacia HIRTA* Nutt. in Torr. & Gray Fl. N. Am. 1: 404. 1840! Type NY! Nuttall, Red River & Arkansas. *Acaciella hirta* (Nutt.) Britt. & Rose. N. Am. Fl. 23: 102. 1928!

As to concept:

A. filicioides auct. non *Mimosa FILICIOIDES* Cav. 1791 *fide* Wiggins (1942).

Var. SHREVEI (Rose) Isely

Plants suffrutescent shrubs, 1—2 m or more. Young stem and leaf rachises villous. Pinnae 9—10 pairs. Leaflets (4) 7—10 mm long with evident secondary venation. Heads usually fasiculate in terminal racemes, sometimes in leaf axils.

Southeastern Arizona (Huachuca Mts., Cochise Co.) and adjacent Sonora.

This variety merges somewhat with robust forms of var. *suffrutescens*. But plants possessing the above specified combination of characters (especially conspicuous nervation of leaflets) are apparently limited (in the U.S.) to the Huachuca mountains; these are var. *shrevei* as I have delimited it.

Acacia angustissima var. **shrevei** (Britt. & Rose) comb. nov. *Acaciella*

SHREVEI Britt. & Rose N. Am. Fl. 23: 105. 1928! Type NY! Isotype US! Shreve 5064. *A. hirta* var. *shrevei* (Britt. & Rose) Kearney and Peebles Jour. Wash. Acad. Sci. 29: 482. 1939!

Acacia LEMMONI Rose Contr. U.S. Natl. Herb. 12: 409. 1909! Type US! Isotype NY! Lemmon, Huachuca Mts., Sept. 1882. *Acaciella lemmoni* (Rose) Britt. & Rose N. Am. Fl. 23: 103. 1928! *Acacia angustissima* subsp *lemmoni* (Rose) Wiggins Contr. Dudl. Herb. 3: 230. 1942!

Var. SUFFRUTESCENS (Rose) Isely

Plant herbaceous to suffrutescent, of small stature to robust, puberulent to hirsute. Petiole-rachises (4)6—10 cm long; pinnae (5) 6—9 (10) pairs; leaflets 15—25 pairs (lowermost leaves often with fewer pinnae and leaflets), usually not nerved. Heads terminally aggregated in fascicled (2—3 per node) racemes and exceeding leaves.

Southern Arizona. Open dry, stony slopes, ledges, washes, canyons; desert grasslands, chaparral. 2400—6200 (7000) ft. (May) July—Sept.

There are several interpretations of the Arizona herbaceous *A. angustissima*. They are largely regarded as forms of var. *hirta* by Benson (1943), and Kearney and Peebles (1960). It is true that var. *suffrutescens* resembles var. *hirta* as to leaf characters more than it (var. *suffrutescens*) resembles typical var. *texensis*. But it is not the same taxon. It differs from var. *hirta* in fewer leaflets and pinnae, and the characteristic terminal aggregation of the heads. It is disjunct from var. *hirta* geographically, and very different ecologically.

Wiggins (1942) recognizes both subspecies *suffrutescens* and var. *hirta* in Arizona. As the above indicates, I am inclined to the viewpoint that the Arizona herbaceous material is largely one taxon; my var. *suffrutescens* includes Arizona material annotated by Wiggins as var. *hirta*, subspecies *suffrutescens* and *A. cuspidata*.

Acacia angustissima var. **suffrutescens** (Rose) comb. nov. *A. SUFFRUTESCENS* Rose Contr. U.S. Natl. Herb. 12: 409. 1909! Type US! Isotype NY! Pringle "Arizona; Santa Cruz Valley near Tucson: 1881." *Acaciella suffrutescens* (Rose) Britt. & Rose. N. Am. Fl. 23: 103. 1928! *A. hirta* var. *suffrutescens* (Rose) Kearney & Peebles Jour. Wash. Acad. Sci. 29: 482. 1939! *A. hirta* subsp. *suffrutescens* (Rose) Wiggins. Contrib. Dudley Herb. 3: 232. 1942!

Var. TEXENSIS (T. & G.) Isely

Plants herbaceous to suffrutescent. Leaves small, petiole-rachises mostly 2.5—4.0 cm long; pinnae (3) 4—6 pairs; leaflets 9—15 pairs. Inflorescences largely intercalary. Flowers usually 4—6.

Southern and western Texas and southwestern New Mexico. Rocky hillsides, canyons, outcrops, limestone to igneous or sandy soils, with pinyon-juniper and juniper-oak to creosote bush and grasses. ?—4500—6300 ft. May—Sept.

The blending of this form with var. *hirta* seems complete, but the tendency towards small leaves with fewer leaflets and pinnae has a distinct geographic orientation, albeit an apparently discontinuous range.

Since the line between the varieties *hirta* and *texensis* is foggy, the viewpoints and definitions of authors are various. Wiggins (1942) and Turner (1959) have treated var. *texensis* at the specific level (as *A. cuspidata* and *A. texensis* respectively); Kearney & Peebles (1960) doubt that it deserves recognition, and Benson (1943) has it as var. *cuspidata* of *A. angustissima*. I can compare my interpretation most easily with that of Wiggins re annotated sheets; my var. *texensis* consists of a melange of his *A. cuspidata* and *A. angustissima* var. *hirta*. Wiggins states, "It is often difficult to put into words the nearly intangible characteristics which make up the 'facies' of a particular plant. One recognizes a difference in two entities, but tries in vain to describe it." Contrariwise, despite its partially clinal nature, I find var. *texensis* relatively simple to define and recognize. I admit some uncertainty as to the ultimate virtue of the variety in terms of its apparently broken range and irregular patterns of morphological variance.

Acacia angustissima var. **texensis** (T. & G.) comb. nov. *A. TEXENSIS* T. & G. Fl. N. Am. 1: 404. 1840! Isotype NY! Drummond 155. *A. filicioides* var. *texensis* (T. & G.) Small Bull. N.Y. Bot. Gard. 2: 93. 1901! quoad nom. *Acaciella texensis* (T. & G.) Britt. & Rose N. Am. Fl. 23: 100. 1928!

A. CUSPIDATA Schlecht. Linnaea 12: 573. 1838! sensu Wiggins, 1940; non *A. cuspidata* Cunn. ex Benth. Lond. Jour. Bot. 1: 337. 1842! *A. angustissima* var. *cuspidata* (Schlecht.) Benson Amer. Jour. Bot. 30: 238. 1943!

Small's *A. filicioides texensis* (T. & G.) is not enumerated in the Gray cards nor cited by Britton & Rose (1928). Small employed this name to refer to glabrous forms of var. *hirta*; he took up *A. cuspidata* for the taxon herein under discussion. But the combination nomenclaturally must apply in the sense of T. & G.

ACACIA BERLANDIERI Benth.

Southern Texas, west to Brewster Co. Adjacent Mexico. Brush country on rocky hills, slopes or flats, limestone outcrops, often with mesquite-oak or cactus-mesquite. Locally abundant. March—May.

Chromosome number 2n = 26 (Turner, 1959)

Re distinctions from the related *A. roemeriana*: leaflets of *berlandieri* are considerably smaller and pinnae more numerous; the pod is coriaceous, not membranous. I have seen several specimens that putatively might be intermediate between *A. berlandieri* and *roemeriana*; all are from the area of range overlap. Among such material, I have rendered (possibly arbitrary) determinations on the basis of pod characters.

Gray's *A. tephroloba* is characterized "by its sparingly aculeate branches, glabrate foliage, and long, flat, stipitate pods." These are all characters in which *A. berlandieri* is quite variable. *A. emoryana* Benth. represents a glabrate or slightly pubescent form of this species with relatively few pinnae and leaflets and a somewhat spicate inflorescence. The original material cited by Bentham is Texas, Wright (uplands of the Leon River western Texas, June) and Emory Expedition no. 325. I have seen the latter collection. Several sheets fall into this descriptive category. There is some degree

of character correlation, and a subspecific unit may exist; I am not sure it can be dismissed as easily as Turner (1959) has done. The problem may be: do these forms represent intermediates with *A. roemeriana*, or are they best regarded as variants within *A. berlandieri*? Presently I am inclined towards the latter viewpoint.

Acacia berlandieri is possibly the most common and conspicuous acacia in southern Texas. One may easily observe areas of hundreds (thousands?) of acres on which it is codominant with mesquite, or almost entirely dominant.

Acacia BERLANDIERI Benth. Lond. Jour. Bot. 1: 522. 1842! Isotype GH! Berlandier 132, Monterey (Nouveau Leon), Janvier, 1828. *Senegalia berlandieri* (Benth.) Britt. & Rose N. Am. Fl. 23: 109. 1928!

Acacia TEPHROLOBA Gray Pl. Wright. 1: 65. 1852! Syntypes GH! Wright 175 & 176.

A. EMORYANA Benth. Trans. Linn. Soc. Lond. 30: 522. 1875! Isosyntype NY! US! Emory Expedition No. 325. *Senegalia emoryana* (Benth.) Britt. & Rose N. Am. Fl. 23: 109. 1928!

Bentham's description of *Acacia berlandieri* (loc. cit.) cites "Berlandier, Monterey, Texas." It is my assumption that GH sheet marked as above indicated represents this collection.

ACACIA CONSTRICTA Benth.

Trans-Pecos Texas (introduced further east?) to southeastern Arizona, (north to Gila Co.), possibly introduced in California. Rocky arid slopes, among talus, flood plains and washes, canyons; with pinyon-juniper, creosote-grass, mesquite on washes and flood plains, local or abundant; infrequently in cultivation. Ca 2000—6500 ft. (April) May—Sept. (Nov.)

Chromosome number 2n = 52 (Turner, 1959)

The distribution of *A. constricta* (to my knowledge) is entirely trans-Pecos and west except for disjunct collections from Martin and Starr Cos., Texas. Records east and south of the trans-Pecos largely prove to be *A. smallii.*

The delineation of *A. constricta* with respect to *A. neovernicosa* is briefly discussed under the latter. Var. *paucispina* Standl. per the author's diagnosis refers to a larger tree (not a thicket forming shrub) with fewer spines, and less glandular leaves; the type is a specimen lacking spines. It is said to grow at a higher altitude than var. *constricta*, distribution Arizona and possibly New Mexico.

Perhaps Standley's concept represents certain distinct ecotypes; or perhaps it is nothing at all. Herbarium specimens lead to no decision. The degree of spine development is variable; I do not find the correlation with other characters of which Standley speaks.

Acacia CONSTRICTA Benth. in Gray Pl. Wright. 1: 66. 1852! Isotype GH! US! Wright. 162. *Acaciopsis constricta* (Benth.) Britt. & Rose. N. Am. Fl. 23: 96. 1928!

A. constricta var. *PAUCISPINA* Wooton & Standl. Bull. Torr. Club 36: 105. 1909! Type US! Metcalfe 1123.

Bentham's concept and cited material (most of which I have seen, GH and US) of *Acacia constricta* included both *A. constricta* and *neovernicosa* as herein delineated, viz. "pinnis 2—7 jugis," and "most of the numerous flowering specimens gathered by Mr. Wright during the past year have not only the branchlets but the foliage glutinous, so that they adhere to the paper in which they were dried." Standley (1919), in characterizing *A. vernicosa* (*neovernicosa* of present treatment; Standley's name was a later homonym) excluded (from *A. constricta*) those elements properly associated with *A. vernicosa*. Among cited material representing the original *A. constricta*, he chose as a type a specimen representing "the form with numerous pinnae": Wright 162(US).[5]

ACACIA FARNESIANA (L.) Willd.

Southern peninsular Florida and Keys; sporadically eastern Florida to southernmost Georgia (introduced). West Indies to northern South America. Pinelands, hammocks, roadsides and other disturbed areas, locally common; in cultivation and escaped into disturbed areas. March—April or (extreme south) all year.

Chromosome number 2n = 52 (Darlington and Wylie, 1956)

Acacia farnesiana (L.) Willd. in the traditional sense is the most widely distributed species of *Acacia*. It ranges from South America to the extreme southern United States, is present also in southern Europe in cultivation and in tropical Asia and Australia independent of cultivation. Whether the range is bihemispheric prior to dissemination by man is moot; Old World botanists appear to believe it to be native.

I suggest the likelihood that *A. farnesiana* is a middle American species (to northern South America); its characters so indicate. Old World material seems much less variable than that of the American tropics; perhaps populations have been derived from relatively few phenotypes introduced at an admittedly early date. *A. farnesiana* is also credited to extratropical South America and names as *A. adenopa* Hook & Arn., *A. cavenia* (Molina) Hook & Arn., and *A. acicularis* Willd. assigned to *A. farnesiana*. I have not seen the types. However, I have examined a suite of specimens representing the South American members of this complex. Largely designated *A. cavenia*, they are certainly allied to *A. farnesiana* but probably not of that species as I have delimited it.

Small (1933) considered the U.S. representatives of *A. farnesiana* (as *Vachellia*) in the broad sense to represent 4 species. I agree with Small's basic position but find his circumscriptions unsatisfactory. I break the complex into three groups which I can only designate as species (*A. farnesiana*, *pinetorum*, and *smallii*.[6]

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[5] Technically, one supposes, the gatherings designated Wright 162 at US (Standley!) and GH (Isely!) represent isotypes. The sheet to be designated as the lectotype should be at K.

[6] One is aware of implicit taxonomic and nomenclatural dangers which beset the worker attempting revisionary efforts working with but a small segment of a cosmopolitan complex. Obviously a study of *A. farnesiana* (sens. lat.) on a world-wide basis is required.

A farnesiana and *pinetorum* are sympatric in southern Florida but differ in several features, most conspicuously in leaflet venation and size and in pod shape. *A smallii is* largely a species of more arid climates; it is primarily of southern Texas and south into Mexico and west to California.

Acacia farnesiana (L.) Willd. Sp. Pl. 4: 1083. 1806! *Mimosa FARNESIANA* L. Sp. Pl. 521. 1753! *Vachellia farnesiana* (L.) Wight & Arn. Prodr. 272. 1834!

I have seen no previous reference to the typification of *Mimosa farnesiana* L. With only a provincial knowledge of *A. farnesiana* and its relatives, the following should be regarded as commentary concerning probabilities rather than critical typification.

There is no specimen in the Linnaean herbarium (Savage, 1945). The Linnaean description scarcely identifies the species; "partialibus octojugatis" is descriptive of leaves with more pinnae than our forms.

Linnaean citations: "Hort Ups. 146; Ald. farnes. 2; Ray. Hist. 977." Hortus Upsaliensis (loc. cit., 1748) provides a characterization from which the Linnaean 1753 entry is a synopsis. Here Linnaeus indicates habitat "Domingo," and the pod description "Legumina teretia, crassa, utrinque angustiora, obtusa" suggests the probability that his concept represented a member of the *A. farnesiana* complex rather than such West Indies relatives as *A. tortuosa* or *A. macracantha.*

Aldinus' (loc. cit., 1625) plate illustrates fruit almost certainly of the *A. farnesiana* complex, although his material presumably came from India. This plate is probably the source of Linnaeus' statement that the leaves have eight pairs of pinnae. Ray's characterization (loc. cit., 1686) is a summary of the Aldinus diagnosis.

In light of the above, I am taking up *A. farnesiana* in the sense of a West Indies species which has pods of the type described by Linnaeus and illustrated per Linnaean citation by Aldinus.

Since I have recognized three species within the US portion of the range of the *A. farnesiana* complex, it is next necessary to decide to which of these, if any, the name, *A. farnesiana,* properly has reference. *A. farnesiana* as above delimited is the predominant representative of the *A. farnesiana* complex in the West Indies. Among a considerable suite of specimens examined (NY), I find only 2—3 which may represent another member of the group. It would appear reasonable that the Linnaean concept included the species common in the West Indies which extends northward into Florida. Thus, I am using *Acacia farnesiana* in the same sense as Small's (1933) *Vachellia farnesiana* (he does not indicate the basis for his nomenclatural interpretation). Britton and Rose (1928) also employ the binomial *Vachellia farnesiana,* but in the sense of *A. farnesiana, pinetorum* and *smallii* of my circumscriptions.

ACACIA GREGGII Gray

Southern Texas to southern California, Mexico. See varietal treatment. Cat-claw.

Acacia greggii and *wrightii* have been recognized as separate species since their description by Gray. I have broadened the circumscription of *A. greggii* to include the type of *A. wrightii* and am treating the two entities at the varietal level. I have done this because I cannot consistently distinguish between the two, because *A. wrightii* (southern to western Texas) lies largely within the range of the more widespread *A. greggii*, and because I have not observed evidence of ecological isolation.

KEY TO VARIETIES

1. Seed circular in outline; pod usually strongly constricted, often twisted, subcoriaceous, 1.0—1.5 cm wide; leaflets 3—5 (6) mm long; racemes 2—5 cm long; flowering mostly March—May; Texas to California.
   2. Leaflets glabrous or slightly puberulent; west to trans-Pecos Texas . . . . . var. *greggii*
   2. Leaflets pubescent; Trans-Pecos Texas to California . var. *arizonica*
1. Seed ovate in outline; pod straight-margined or somewhat constricted, not twisted, heavily papery, 1.5—2.5 cm wide; leaflets 5—9 mm long; racemes often exceeding 5 cm; often flowering May—July; southern to western Texas. . . . . var. *wrightii*

Var. ARIZONICA Isely

Leaflets, rachis and petioles villous with mostly straight trichomes 0.2—0.3 mm long; leaflets slightly or conspicuously cinereous, mostly 4—5 (8) mm long, often thick.

Trans-Pecos Texas to southern California. Desert slopes, canyons, road cuts; rocky sandy to clay soil; with *Prosopis*, *Carnegiea*, *Celtis*, *Cercidium*, *Larrea*; occasional to codominant. 2300—5000 ft. April—June.

Var. *arizonica* differs but slightly from var. *greggii* but is neatly circumscribed by range. The two overlap in Trans-Pecos Texas but with apparently little intermediacy.

Acacia greggii var. **arizonica** var. nov.

Foliorum petiolus, rachis necnon foliola pilis plerumque rectis 0.2—0.3 mm longis villosi; foliola subcinerea vel valde cinerea, saepe carnosula, 4—5(8) mm long; caeteris var. *greggii* similis.

Type ISC! Schroeder 114. Arizona, Yavapai Co. Montezuma Well, near Camp Verde. Altitude 3550 ft. July 18, 1948.

Var. GREGGII

Southern Texas to southern California. Adjacent Mexico. Rocky limestone slopes to bottom flood plains with mesquite and grass, washes, roadsides, sandy to igneous soils; often common. March—May (July). ca 500—6000 ft.

The typical, southern and central Texas form of this species has thin, green, glabrous leaves contrasting to the more xerophytic somewhat cinerous types to the west.

Acacia GREGGII Gray Pl. Wright. 1: 65. 1852! Type GH! "Dr. Gregg. West of Patos (dry valley) April 10/47. Small tree (+10 to 20)." *Senegalia greggii* (Gray) Britt. & Rose N. Am. Fl. 23: 110. 1928!

A. DURANDIANA Buckl. Proc. Acad. Phil. 1861: 453. 1862! Type PH! Buck-

ley. near Fort Belknap, Texas. June, 1861.

Gray (original description) states of *A. greggii*: "glabra" and "A small tree, 10 or 20 ft. high. . . ." He cites a Wright collection of 1851 and a Gregg specimen "west of Patos. . . ."

The "type sheet" of *A. greggii* includes material from three gatherings. One of these is the collection I have taken as type and cited per herbarium ticket; the leaflets are glabrous, consistent with the descriptive "glabra." Gray obviously obtained his statement as to height of the plant from the herbarium label of this collection. The other two specimens are Wright collections dated 1851 from west Texas or New Mexico; they are mildly pubescent and are herewith excluded.

Var. WRIGHTII (Benth.) Isely

Southern to western Texas. Rocky slopes to flood plains or washes; mesquite scrub; sandy to caliche soils. (April) June—August.

It is possible (or probable) that var. *wrightii* represents an independent species as previous workers have considered it. If so, satisfactory diagnostic characters are needed. Var. *wrightii* contrasts to *greggii* in leaflet size, length of racemes, pod texture and width, degree of constriction and twisting; and shape of the seeds. There is a tendency for these characters to coincide as indicated in the key, but correlation is inconsistent, and except for seed shape, all seem quantitative. I have used seed shape as a "basic character." But not enough material has seeds to allow a reasonable test of the hypothesis, and designation of some flowering material is uncertain. I believe, per specimens, that var. *wrightii* usually flowers later than *greggii* but there is overlap and inconsistency.

Acacia greggii var. **wrightii** (Benth.) comb. nov. *A. WRIGHTII* Benth. in Gray Pl. Wright. 1: 64. 1852! Isosyntype GH! Wright 302, 1849 collection. "Hills of Rio Grande and east to San Antonio" *Senegalia wrightii* (Benth.) Britt. & Rose. N. Am. Fl. 23: 110. 1928!

Bentham cites three gatherings, two of Wright and one of Gregg. The Gray herbarium "isotype" represents more than one Wright collection. One of these is designated as above quoted. Bentham's citation was "Prairies west of San Antonio and on the Rio Grande, Texas"—number and year not given. I take Wright 302 as a duplicate of one of the gatherings seen by Bentham. The US! "type" specimen is "Wright 173 . . . 1849." It is *A. wrightii* plus extraneous material, possibly *A. berlandieri.*

Since *A. greggii* and *wrightii* were published simultaneously and since neither has previously been subordinated to the other, an arbitrary choice is necessary. Var. *greggii* is the more widely distributed form; I have thus maintained it as the "typical" variety.

ACACIA MACRACANTHA Willd.

Southern Florida and Keys, local. (Only 3 U.S. specimens seen). Sand ridges, mangrove swamps, hammocks. West Indies and northern South America.

A. macracantha is a tropical American complex of uncertain delimitation

and scarcely studied internal patterning. It was first reported from the United States by Ward (1967). Britton and Rose (1928) took up *Poponax macracanthoides* for West Indies material, limiting, apparently, *A. macracantha* to South American members of the complex. I have examined suites of specimens (NY & US) ranging from the Antilles to South America. I find the northern material considerably less pubescent than that from South America, but observed no sharp delineation on this or other characters, although there is much variance in pinnae number, pod shape and thorn architecture. My arbitrary interpretation of *A. macracantha* is then in the broad sense.

Florida material of *A. macracantha* differs somewhat from West Indies gatherings which typically have (10)15—25(30) pairs of pinnae and ca 30 pairs leaflets. Perhaps our Florida populations deserve varietal status, but I do not know enough about the species to draw conclusions.

Acacia MACRACANTHA H. & B. ex Willd. Sp. Pl. 4: 1080. 1806!

Mimosa LUTEA Mill. Gard. Dict. ed. 8, no. 17. 1768! Photo of type US! Houston Jamaica, 1731. *Acacia lutea* (Mill.) Hitch. Rep. Mo. Bot. Gard. 4: 83. 1893! *Acacia lutea* (Mill.) Britt. Bull. Torr. Bot. Club 16: 327. 1889! *Poponax lutea* (Mill.) Britt. & Rose N. Am. Fl. 23: 90. 1928! Non *A. lutea* Leavenw. 1824!

A. MACRACANTHOIDES Bert. ex DC. Prod. 2: 463. 1825! *Poponax macracanthoides* (DC.) Britt. & Rose N. Am. Fl. 23: 89. 1928!

Bentham (1875) examined the Humboldt and Bonpland material typifying this species. He cites additional synonyms.

ACACIA MILLEFOLIA Wats.

Southern Arizona. Mexico. Ledges, desert grassland, open rocky slopes, foothills. Locally abundant. 4000—5000 ft. July—August.

Acacia MILLEFOLIA Wats. Proc. Amer. Acad. 21: 427. 1886! Type GH! Isotype US! Palmer 45 "Chihuahua, Hacienda San Jose, Aug. 1885." *Senegalia millefolia* (Wats.) Britt. & Rose N. Am. Fl. 23: 111. 1928!

Watson cites two collections, one each of Palmer and Pringle. I have seen both and take the Palmer specimen as lectotype.

ACACIA NEOVERNICOSA Isely

Western Texas to adjacent New Mexico, slightly to southeastern Arizona. Desert plains, stream-beds, canyons, rocky calcareous hills with juniper and/or with *Larrea*; locally codominant. Ca 3000—5000 ft. April—Aug.

Chromosome number 2n = 26 (Turner, 1959).

Acacia neovernicosa falls within the range of *A. constricta* or extends slightly further to the east, but is more limited in distribution. Since it and *A. constricta* are not separated geographically, nor apparently ecologically, one looks for a compatibility barrier. Such a barrier seems made to order in chromosome number reports: *A. neovernicosa* a diploid and *constricta* a tetraploid (Turner, 1959).

Per herbarium sheets, *A. neovernicosa* and *A. constricta* are sufficiently similar that much material is confused. Standley (1919), and Benson (1943)

reduced *A. neovernicosa* (as *vernicosa*) to varietal status. Turner (1959) maintained both species and remarked on phenological and ploidy differences between *A. neovernicosa* and *A. constricta*. I recognize *A. neovernicosa* on the pragmatic basis that I find little evidence of intermediacy between it and *A. constricta*; in the evolutionary sense, I presume it may be the ancestral form from which the more successful tetraploid, *A. constricta*, was derived.

Acacia **neovernicosa** Isely nom. nov. *A. VERNICOSA* Standl. Contr. U.S. Natl. Herb. 20: 187. 1919! Type US! Isotype NY! and GH! Palmer 385. *Acaciopis vernicosa* Britt. & Rose. N. Am. Fl. 23: 96. 1928! *Acacia constricta* var. *vernicosa* Benson Amer. Jour. Bot. 30: 238. 1943! Non *A. vernicosa* Fitz. 1904.

My thanks to Dr. Velva Rudd who directed me to an earlier homonym of Standley's *A. vernicosa*. The Benson, and Britton and Rose names were published as new combinations. As their basionym was illegitimate, they can only be taken up as new names.

ACACIA PINETORUM Hermann

Southern peninsular Florida (Lee Co. south) and Keys. Infrequent in West Indies. Pinelands, scrub adjacent to ocean, clearings in hammocks. March—April or all year.

This species is, I presume, a local derivative of *A. farnesiana*. It is easily discernible from the latter by its small leaves with tiny veinless leaflets and its sharply tapering or beaked pods. Spines are consistently present—they are almost invariably slender, never thickened at the base as frequently in *A. farnesiana*.

Acacia pinetorum Hermann Jour. Wash. Acad. 38: 237. 1948! *Vachellia PENINSULARIS* Small Man. Se. Fl. 654, 1505. 1933! Syntypes NY! Small and Carter 2975, Hammocks, Long Key (Everglades); Small and Wilson 1778, in Pinelands, Long Key. Neque *Senegalia peninsularis* Britt. & Rose. 1928! neque *A. peninsularis* (Britt. & Rose) Standl. 1936!

Vachellia INSULARIS Small Man. Se. Fl. 655, 1505. 1933! Syntypes NY! Small and Mosier 6018, pinelands, Big Pine Key, Monroe Co., Florida; Small et al 3549, pinelands, Big Pine Key. Non *A. insularis* A. Rich. 1845!

As to concept:

A. farnesiana auct. plur. non L. 1753.

See *A. farnesiana* for consideration of the Linnaean *A. farnesiana*. Hermann's epithet is a substitute for *peninsularis* of Small and he cites only that name. I have added *V. insularis* to the synonymy on taxonomic grounds. Were that name available, it would take precedence over *A. pinetorum*, but it also is preoccupied.

ACACIA RIGIDULA Benth.

Southern to western Texas and adjacent Mexico. Thorny brush country, rocky slopes, limestone bluffs, fence rows; with mesquite, live oak, etc.; sandy silt to clay soils; locally common. (Feb.) March—April.

Chromosome number 2n = 26 (Turner, 1959)

It may be that *A. rigidula* is conspecific with *A. amentacea* DC. as per Standley (1922). Mexican *A. amentacea* which I have examined appears almost identical except for fewer leaflets. Viewpoints regarding differences between *A. rigidula* and *A. amentacea* are expressed by Turner (1959) and Britton and Rose (1928). I have presently adopted Turner's delimitation.

Acacia RIGIDULA Benth. Lond. Jour. Bot. 1: 504. 1842! *Acaciopsis rigidula* (Benth.) Britt. & Rose. N. Am. Fl. 23: 94. 1928!

Among Texas species, Bentham's description could hardly apply to any other.

ACACIA ROEMERIANA Scheele

Central to western Texas. Adjacent Mexico. Rocky limestone soils, creek banks in "brush country" with juniper, live oak, thorn, etc.; roadsides; sporadic or frequent. (March) April (May).

As to material seen, the U.S. range of *A. roemeriana* is a compact triangle from Presidio Co., Texas, to Taylor Co. and Bexar Co. (except: a disjunct collection from the Lower Rio Grande Valley, Starr Co., Texas; and one from southern Eddy Co., New Mexico). The related *A. berlandieri* lies primarily to the south and east. Putative intermediates between the two species come primarily from the overlap area. Pod width in *A. roemeriana* is diverse; the broad (2.5—3.5 cm) and narrow (1.0—1.5 cm) extremes appearing very different.

Standley (1922) takes up not only *A. roemeriana* but *A. micrantha* and *A. malacophylla*. I have seen types of both of the latter and am assigning them to *A. roemeriana*. The Wright collection on which *A. malacophylla* was based seems to be *A. roemeriana* except that it is pubescent. Turner (1959) was unable to find any material resembling *A. malacophylla* from the area of the type locality in Uvalde Co., Texas. Certain Palmer collections from Uvalde Co. (MBG), however, seem to represent the subject populations. They differ from "typical" *A. roemeriana*, not only in their velutinous pubescence, but rather narrow pods, 1.0—1.5 cm wide. Possibly they represent a local biotype of varietal status.

Acacia ROEMERIANA Scheele Linnaea 21: 456. 1848! *Senegalia roemeriana* (Scheele) Britt. & Rose. N. Am. Fl. 23: 115. 1928!

A. MALACOPHYLLA Benth. in Gray Plant Wright. 1: 64. 1852! Photo of type NY! Wright 172. *Senegalia malacophylla* (Gray) Britt. & Rose. N. Am. Fl. 115. 1928!

A. MICRANTHA Benth. Trans. Linn. Soc. 30: 526. 1875! Isotype NY! Berlandier 3148. Non *A. micrantha* Desv. ex Hamilton 1825!

A. PALMERI Wats. Proc. Amer. Acad. Arts Sci. 17:350. 1882! Type GH! Palmer 298, Sierra Madre so of Saltillo. *Senegalia palmeri* (Wats.) Britt. & Rose. N. Am. Fl. 23: 115. 1928!

I have not seen Scheele's specimen of *A. roemeriana*. His description indicates probable identity of the material with the present concept of *A. roemeriana*.

ACACIA SCHAFFNERI (Wats.) Hermann

See varietal treatment.

A. schaffneri and *A. tortuosa* represent American complexes allied to *A. farnesiana, smallii*, etc. Woodson and Schery (1950) have questioned whether *A. tortuosa* is distinct from *A. farnesiana* in the broad sense. I have seen limited evidence of such an issue; the pods of *A. tortuosa* and *schaffneri* are quite different from those of *A. farnesiana* and *smallii*. The taxonomic problems instead are whether *A. schaffneri* of northern Mexico should be considered to fall within the specific limits of *A. tortuosa* of the West Indies and southernmost Florida, and with which of these entities (if either) the southern Texas material is most closely associated.

Precedent goes in several directions. *Poponax schaffneri* (Wats.) Britt. & Rose was taken up by Britton and Rose (1928) for both the southern Texas and Mexican elements, *A. tortuosa* being limited to the West Indies. Rzedowski's (1963) circumscription is similar; he limits *A. schaffneri* to the "Altiplano de Mexico y algunas zonas adyacentes." Turner (1959) has asserted that *A. schaffneri* and *tortuosa* are separate species, but that the Texas representatives are *tortuosa*.

Typical *A. schaffneri* (Mexico) and our Texas populations contrast with *A. tortuosa* of Florida and West Indies in several features (pods, petiole-rachis glands, degree of reticulation of leaflets, pubescence), and I am disinclined to designate both Florida and Texas material as *A. tortuosa*. My *pro tem.* delimitation of *A. tortuosa* restricts it to the Antilles (from whence comes the type) and Florida.

Acacia schaffneri as represented in Mexico is certainly allied to the taxon of southern Texas (*A. tortuosa* of Turner), and the two are geographically contiguous. Members of the complex vary conspicuously in length of the pods, number of pinnae, length and diameter of flowering peduncles, and thickness of flowering twigs. In southern Mexico there is further variance and perhaps intermediacy (as per Woodson and Schery suggestion) with certain elements of the *A. farnesiana* complex. I believe there are two (or more?) taxa at least at the varietal level.

My interpretation:

1. Twigs of flowering branches stout, 4—6 mm in diameter; pinnae 3—5(6); flowering peduncles stout, various in length but often less than 1.5 cm long. . . . . var. *schaffneri*

1. Twigs of flowering branches slender, 2—4 mm in diameter; pinnae 2—3(4); flowering peduncles slender, often curved, (1.3)2—3 mm long. . . . . var. *bravoensis*

Var. SCHAFFNERI

Not in United States.

Acacia schaffneri (Wats.) Hermann Jour. Wash. Acad. Sci. 38: 236. 1948!

Pithecellobium SCHAFFNERI Wats. Proc. Amer. Acad. 17: 352. 1882! Type GH! Parry and Palmer 219. *Poponax schaffneri* (Wats.) Britt. & Rose. N. Am. Fl. 23: 89. 1928!

Acacia SUBTORTUOSA Shafer in Britt. & Shafer. N. Am. Trees 524. 1908!
Syntypes MBG! and US! Palmer 11 & 510, Durango, Mexico.

Watson's *Pithecellobium schaffneri* was a mixture both as to description ("filaments united at base") and material. He cited three specimens. Two of them are a species of *Pithecellobium*; the third (above cited) is of the entity under consideration. Rzedowski (1963) typified the binomial on the basis of the Parry and Palmer gathering so that its traditional application could be maintained. I have also seen the subject material and concur with his decision.

Var. BRAVOENSIS Isely

Southern Texas and adjacent Mexico. Loam to clay calcareous soils; usually with other brush, especially mesquite; roadsides; locally abundant. Feb.—March (April).

The majority of herbarium specimens of *Acacia schaffneri* var. *bravoensis* and *A. smallii* lack fruit and are frequently confused. They may be distinguished on basis of flowering peduncles, location of foliar glands, and reticulation (or lack of it) of the leaflets as defined in the key.

Acacia schaffneri var. **bravoensis** var. nov.

Ramuli ramorum florigerorum graciles 2—4 mm diam. Pinnae 2—3(4)-jugae. Pedunculi graciles saepe incurvi (1.3) 2—3 mm longi. Caetera var. *schaffneri*. Type SMU! F.B. Jones 100. Texas, San Patricio Co.: 7 miles south of Taft in clay loam soil. March 29, 1950.

As to concept:

Acacia subtortuosa Shafer in Britt. & Shafer. N. Am. Trees. 524. 1908! quoad descriptio non typus.

A. tortuosa sensu Turner Leg. Tex. 36. 1959! Non *Mimosa tortuosa* L. 1759.

Acacia subtortuosa Shafer, as to description, is our plant. Further, Shafer gives it the common name, "Rio Grande Acacia" and refers to its occurrence in Texas (here he says southwestern rather than southern Texas; this I presume to be an error; there is no *Acacia* resembling his *A. subtortuosa* in western Texas). His types (Palmer 11 and 510; perhaps chosen at a later date) unfortunately are of typical *A. schaffneri*; from Durango, they are well outside of the range of the Rio Grande Acacia. So I take up Shafer's appropriate common name.

ACACIA SCHOTTII Torr.

Texas, Brewster Co., and presumably adjacent Mexico. Sandy washes along Rio Grande and lower desert slopes, Chisos mountains. Local. April—July.

Possibly *A. schottii* is a local derivative of *A. neovernicosa*. If so, it represents a distinctive series of populations which, within their limited range, are apparently quite successful: "The species is locally abundant, often dominating the community in which it occurs." (Turner, 1959).

Acacia SCHOTTII Torr. Bot. Mex. Bound. Surv. 62. 1859! Type NY! Isotype GH! Parry, Comanche Crossing, near San Carlos. *Acaciopsis schottii* (Torr.) Britt. & Rose. N. Am. Fl. 23: 96. 1928!

ACACIA SMALLII Isely

Western Florida panhandle to western Texas, sporadically to southern California; Mexico. Open disturbed areas, roadsides, woodland margins; grassland to cactus-mesquite flats, sandy-loam or clay soils. Cultivated as ornamental. (Jan.) March—May.

Material of *Acacia smallii* has usually been assigned to *A. farnesiana* in the past. The relationship of *A. smallii* to its immediate congeners (*A. farnesiana* and *A. pinetorum*) is discussed under *A. farnesiana*. In the United States, it differs easily from *A. farnesiana* in features such as leaflet venation, pod shape, and usual peduncle length. I am not sure that these distinctions are equally valid in southern Mexico.

A smallii is more widely distributed in the United States than either of its evolutionary neighbors (*A. farnesiana* or *pinetorum*); it occupies a greater variety of climatic regimes; and it is somewhat more variable morphologically. It is, in the United States at least, entirely disjunct from the above named species.

I have seen *Acacia smallii* as far east as Pensacola, Florida; it is yet well disjunct from *A. farnesiana* which is from the lower peninsula and the eastern margin. But Gulf Coast *A. smallii* is infrequent; it comes into its own only in southern Texas. Its western range is given some continuity by its use in cultivation. Its native range is apparently discontinuous (at least in U.S.). It "plays out" in western Texas; the only undoubtedly native *A. smallii* I have seen from Arizona is limited to the Baboquivari Mts. *A. smallii* of Arizona and California seems essentially identical to that of Texas except that the leaflets are usually strongly hirsutulous and may possess weak venation.

Acacia smallii is extremely variable as to spine development. Strongly spiny and unarmed plants may be found in the same colony.

Acacia **smallii** nom. nov. *Vachellia DENSIFLORA* Alexander ex Small Man. Se. Fl. 655, 1505. 1933! Syntypes NY! Isosyntypes US! Small & Alexander, April 16, 1931 and Aug. 1931. Both "along Bayou La Fourche near cut-off, Louisiana." *A. densiflora* (Small) Cory Rhodora 38: 406. 1936! Non *A. densiflora* Morrison. 1912!

As to concept:

A. farnesiana auct. plur. non L. 1753.

J. K. Small was the first to recognize that the traditional United States *A. farnesiana* consisted of more than one taxon; the proposed name then seems especially fitting.

ACACIA TORTUOSA (L.) Willd.

Southern Florida and West Indies. Shell mounds and roadsides. Local. April—June and possibly all year.

Acacia tortuosa represents a West Indies or West Indies-Mexican-Central American complex of uncertain delimitation. I refer Mexican-Texas material which has been called *A. tortuosa* to *A. schaffneri* (see discussion under that

species). *A. tortuosa* as it occurs in Florida is in general similar to that of the West Indies (whence comes the type).

Although I have seen several sheets of *Acacia tortuosa* from southern-most Florida, most of them come from a few localities; the species is apparently at best occasional. Its nativity in Florida is problematic (Ward, 1968).

Acacia tortuosa has much the aspect of the more common *A. farnesiana*, and matches that species in possessing reticulate leaflets. It differs in averaging more pinnae; the leaves are shorter petioled with the usually large, elongate gland tending to be distally located; the comparatively slender pod tends to be moniliform. In U.S. material at least, there is much less thorn variance than in *A. farnesiana*; the thorns are always well developed and almost never white.

Acacia tortuosa (L) Willd. Sp. Pl. 4: 1083. 1806! *Mimosa TORTUOSA* L. Syst. Nat. ed. 10. 1312. 1759! Microfiche of Linnaean material! (Savage catalogue 1228: 27).

Willdenow cites L. Sp. Pl. 1505. This is the correct pagination for ed. 2. 1763. The description is an expansion of *M. tortuosa*, 1759, cited above.

The Linnaean specimen marked *Mimosa tortuosa* (in Linnaeus' handwriting) is a Patrick Browne gathering from Jamaica. Linnaeus bought the Browne herbarium in 1758. I believe it reasonable to presume it to be the basis of the Linnaean diagnoses (1759 and, slightly expanded, 1763). Unfortunately, important critical characters of the gathering are not discernible from the microfiche.

Tropical American synonymy for *A. tortuosa* is enumerated by Bentham (1875) and Britton and Rose (1928).

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THE GENUS RHEXIA (MELASTOMATACEAE)

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The recent and capable revision of *Rhexia* done by Dr. C. W. James (1956) precludes any necessity for extensive reiteration here of the morphology or nomenclatural history of these North American melastomes. However, since that work was done much more information about the genus has been obtained as a result of cytological-anatomical research together with some additional field observations and collections. These, including as they do an additional, well-marked, species and a more intensive field survey of the genus, point toward some emendation.

As James (l.c.) has stated, *Rhexia* is exclusively North American with its greatest concentration of species in the southeastern part of the coastal plain of the U.S.A. Only one (*R. virginica*) extends north as far as Canada; only one (*R. cubensis*) ranges south beyond the United States. Thus, from the standpoint of U.S. botanists, it is a most accessible genus. Fourteen taxa are recognized by James.

The habitat of most *Rhexia* is boggy, a majority of the species being found in such poorly drained areas as bogs, pine flatwoods, savannas, and peaty ditches, invariably on acid, usually sandy, substrates. A majority of species is weedy, coming in rapidly after soil disturbance, burning, logging, etc., and usually being winnowed out by subsequent successional pressures.

The observations made by James and prior authors provide a practical morphological basis for a sectional treatment of the genus, namely that on a basis of pollination mechanism, intergradation, and ecological amplitude, two clearly marked series (A and B) appear to exist. *Rhexia nuttallii*, *R. petiolata* and *R. lutea*, comprising the former series, have short, straight, ascending anthers, show no tendency to cross-pollinate or at least do not produce successful hybrids, tend to have strikingly uniform morphologies over their range, and are less weedy. On the other hand most of the latter series (with the exception of *R. parviflora* and *R. alifanus*) do produce successful hybrids, show considerable diversity of morphology over their ranges, and are often weedy. This latter series is therefore the most problematic. Many of the species are rhizomatous or show a combination of rhizomes and tubers. (Population studies of these are fraught with difficulty in that such species can form clones of enormous extent by means of extensive underground systems so that what at first appears to be a large, rather uniform, population may actually comprise but a few plants.) James recognized nine species (*R. alifanus*, *R. aristosa*, *R. cubensis*, *R. interior*, *R. mariana* var. *mariana* and var. *exalbida*, *R. nashii*, *R. parviflora*, *R. ventricosa*, and *R. virginica*) as making up series B, but had reservations regarding the position of *R. alifanus* within this assemblage.

SIDA 3 (6): 387—440. 1969.

Our own, more recent, work has involved some change in approach to the taxonomy of the genus, particularly as to the following:

(1.) On a basis of chromatographic and anatomical analysis of plant parts it would appear that *R. lutea* in series "A" and *R. alifanus* in series "B" of James may actually represent distinct sections.

(2.) Field observations of the species bear out what James discovered regarding hybridization between the Rhexias of series B, but also indicate that a greater degree of hybridization is going on than was formerly recognized. This is supported by collection of F-l's and backcrosses from hybrid swarms, by cytological investigation of species, and by breeding studies of species. Further discussion of these phenomena will follow.

(3.) The complex of forms which either make up or relate to *R. mariana* appears to require a different circumscription. It is recognized that *R. mariana* var. *mariana* is difficult to distinguish either from *R. interior* (*sensu* James) or *R. ventricosa* (*sensu* James). These latter entities differ very little in overall morphology; were their ranges contiguous they would doubtless be considered as one unit. Both have resemblances in their wide leaves and subequal stem faces to *R. virginica* as well but are "marianalike" in their exclusively rhizomatous habit as well as in their character of hypanthium and seed. Both are weedier than *R. virginica*; both hybridise with *R. virginica* as well as with *R. mariana* but hybrids with the former show poor development of seed and capsule while hybrids with the latter do not. The frequency in collections of *R. mariana-R. ventricosa* and *R. mariana-R. interior* intermediates together with the high proportion of seed produced in the capsules of such specimens therefore point to a varietal relationship between all these taxa. (In fact, in that hybrids of *R. nashii* and *R. virginica* show a far greater degree of vigour than do those of *R. mariana* and *R. virginica*, it is reasonable to propose that *R. nashii* actually is more closely related to *R. virginica* than is *R. mariana*.)

A different sort of problem arises when one considers *Rhexia mariana* var. *exalbida* (*sensu* James, Michaux, etc.). The most characteristic form of this entity is a low, slender-rhizomatous, white-flowered, narrow-leaved plant which is hirsute save for the small, sparsely-hairy to smooth hypanthium. Populations of this kind are not uncommon in a region extending from northern Florida northeastward in the coastal plain into eastern North Carolina and as James points out such extremes might well tempt one to treat them as a distinct species (as in fact did Walter, 1788). However, all of the abovenoted characteristics appear to vary independently of each other over the stated range of the entity. For example white-flowered, hairy-hypanthiumed, broad-leaved populations are common in southern Mississippi and southeastern Louisiana; rose-flowered, smoothish-hypanthiumed, narrow-leaved populations are the rule in peninsular Florida; narrow-leaved, larger hypanthiumed, pale-lavender flowered individuals are common in the northeastern part of the range of *R. mariana*. Because of the abovementioned and very demonstrable extremes from within the stated range of *R. mariana* var. *ex-*

albida we have found it difficult to assign even the rank of variety to this assemblage.

In the case of Jame's *R. virginica* var. *purshii* we have also encountered much difficulty in determining its relationship to *R. virginica* proper and find it impossible to delimit this variety in any way useful to a systematic treatment.

(4.) Therefore, on the basis of the abovementioned observations we present a new treatment of *Rhexia*, also incorporating into this a new species of *Rhexia*, *R. salicifolia*, first discovered by Dr. R. K. Godfrey in northern Florida during late summer of 1961. We treat a total of thirteen taxa (including two varieties).

The authors of this paper undertook its first stages independently, but they concur as to what comprise the taxa of *Rhexia* and also are agreed that a combination of their work would enhance the effectiveness and utility of a taxonomic treatment. We base our opinions on greenhouse observations, anatomical studies, breeding experiments (still being continued), cytological evidence, and field experience with *Rhexia* over an area extending from New Jersey south into Florida and west to the limits of the genus in Texas. Over 900 numbers of *Rhexia* have been added to collections as a result; over 2500 duplicates are being distributed to the following herbaria: ALU, C, DS, ENCB, FSU, GH, ILL, KANU, LL, MICH, MISSA, MSC, NCU, NY, P, PH, RSA, SMU, TEX, UC, US, VPI, VT, WIS. Duplicates of most of these numbers are deposited at VDB; vouchers for cytological, anatomical or chromatographic studies are deposited at NCU and/or GEO.

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It is a pleasure to acknowledge the help and encouragement of Dr. R. K. Godfrey of Florida State University at whose suggestion the taxonomic portion of this study was started and who was first to collect the one new species (*R. salicifolia*) treated here.

We wish also to thank curators and staffs of the following institutions for their kindness in providing loans of *Rhexia* for study (abbreviations in accordance with J. Lanjouw and F. A. Stafleu, 1964): DUKE, the Herbarium of Duke University, Durham, North Carolina; FSU, the Herbarium of the Department of Biological Sciences, Florida State University, Tallahassee; NCU, the Herbarium, Department of Botany, University of North Carolina, Chapel Hill; SMU, the Herbarium, Southern Methodist University, Dallas, Texas.

The Latin diagnosis of *Rhexia salicifolia*, sp. nov., was written by Dr. L. H. Shinners.

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The junior author's contributions to this paper are from a thesis submitted

to the Graduate School of the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the Ph.D. degree in Botany. The study was done under the direction of Dr. C. Ritchie Bell. Financial assistance for the junior author was furnished by a National Science Foundation Cooperative Fellowship.

MORPHOLOGY AND ANATOMY

Habit. All *Rhexia* are perennial, their erect or ascending shoots arising annually from erect, subligneous caudices or from slender to stout, horizontally spreading, rhizomes. Perennation is from lateral buds, arising in a rather random fashion from the crown or from the rhizomes; in some species tubers are produced in addition, these usually of a short-oblong or fusiform shape similar to small sweet potatoes. Development from seed is fairly rapid, most of the species reaching flowering size (in greenhouse) within a year. *Rhexia alifanus* and *R. lutea* are exceptional, perhaps because of the additional time required for the seedlings to put down very lengthy taproots. Seedling flats of both seemed to stagnate in the flats while the seedlings of other species were putting on considerable height growth. Later, when the root systems of the former two species were examined it was noticed that the taproots had already reached the bottom of the shallow flats. When these particular seedlings were released by potting them separately in deep clay pots the growth response was both rapid and profuse; however, it is still probably likely that both *R. lutea* and *R. alifanus* do not bloom until the second year and this is also very often the case in nature with the other species as well. No stratification is necessary for abundant seed germination, seed of all species germinating in the greenhouse at any time of year. In nature most germination is probably in the spring, and therefore a period of after ripening may be required. This has not been tested.

Stems. The stems of *Rhexia* toward the base tend to be terete, and in many cases with a development of shreds of corky tissue. In very wet situations the stem bases may become quite thickened and spongy (this is especially noticeable in such wet-ground species as *R. virginica* and *R. aristosa*). Toward the midstem and up to the level of the inflorescence the axis becomes angulate. In *R. aristosa*, *R. mariana* var. *interior*, *R. mariana* var. *ventricosa*, and *R. salicifolia* there are four subequal stem faces; in the former two species the margins of the sessile leaves appear to be decurrent the length of the internode as narrow wings. In the other species of *Rhexia* one pair of stem faces is narrower and concave, the other slightly convex and broader. The two contrasting stem types are best displayed at mid-stem. The stem anatomy is typical of melastomes (Metcalfe and Chalk, 1950). All taxa of the genus have internal or intraxylary phloem. The pith is usually relatively large and is composed of large parenchyma cells. The crystal aggregates so common in the leaves of some taxa are also found in the pith and in the epidermis of the stem. These crystal aggregates are apparently confined to parenchymatous tissues. Stem wings, when present, are always vascularized and the number of vascular bundles seems to depend upon the

degree of development of the stem wings. The interspecific variations in stem structure of the genus are not sharp enough to be useful in the classification of the various taxa comprising the genus.

Leaf arrangement. Leaf arrangement in *Rhexia* is decussate; each pair of opposing leaves is in a plane perpendicular to that occupied by those of adjacent nodes. In *Rhexia* the leaves are either sessile or short-petiolate, with petiole length greatest at the lower nodes of a stem.

Leaves. Leaves of *Rhexia* are simple and in most species three-nerved. In *Rhexia virginica* there may be more than three and in *R. mariana* var. *mariana*, *R. cubensis* and *R. salicifolia* the central nerve only may be conspicuous. In those species with lateral nerves, the nerves are arcuate. The margins may range from subentire to distantly or approximately serrulate, the tips of the very low, ascending teeth often drawn out into fine, gland-tipped, multicellular trichomes. Surfaces of leaves may range from glabrous to hirsute or glandular hairy. Orientation of leaves ranges from slightly recurved to horizontal or sharply ascending. The blades in all species save *R. salicifolia* are situated so that the flat side faces the axis of the plant; in *R. salicifolia* the blades are in a plane perpendicular to the ground, hence the edges of the leaves face the axis. In *R. lutea*, *R. petiolata*, *R. nuttallii*, *R. mariana*, *R. nashii* and *R. virginica* the stomata are concentrated on the lower surface of the blade; in *R. cubensis*, *R. aristosa*, *R. parviflora*, *R. salicifolia*, and *R. alifanus* the stomata are frequent on both surfaces. Stomata of *Rhexia* are ranunculaceous or anisocytic; i.e., they are surrounded by ordinary epidermal cells, usually three in number. *Rhexia alifanus* appears to be significantly different in its stomate density. The mean stomate density for plants of this species (lower epidermis) is 235 per square millimeter, while the average mean density for the remaining taxa is 882. The taxon with the next highest density is *R. salicifolia* with a density of 529. It may be significant that both of these species are xerophytes and that both have stomata on both leaf surfaces.

In its cross-sectional pattern, *Rhexia alifanus* stands out from the other species of the genus because of its peculiar leaves, which are isofacial, i.e., the upper and lower surfaces are indistinguishable except by their orientation to the axis of the plant. The internal structure, except for the vascular tissue is bilaterally symmetrical, both transversely and longitudinally. The palisade mesophyll is biseriate. Each of the two palisade mesophylls consists of two layers of typically "sausage-shaped" cells. A thin spongy mesophyll separates the two palisade layers. Although *R. alifanus* is not the only species with two separate palisade mesophylls, it is the only species in which the internal structure is so symmetrical and in which there are two double palisade layers. This, and other features of the leaf of this species, such as the greatly developed waxy cuticle and the vertical orientation of the leaves, is probably a xeromorphic modification. *R. alifanus* occupies some of the driest habitats of all the species of *Rhexia*, often being found on extremely dry sands or sandy peats. A biseriate palisade mesophyll (two

layers separated by a spongy layer) is also present in the leaves of *Rhexia aristosa* and *R. salicifolia*. These two species, especially the latter, can also occupy xeric sites, and in both, the leaves tend to be vertically oriented.

The leaves of all species of *Rhexia*, except those of *R. alifanus*, are bilaterally symmetrical in the longitudinal plane. Unlike *R. alifanus* the leaves of the other species develop some degree of folding, which may vary from the nearly flat leaves of *R. nuttallii* to the typical V-shape (in cross-section) of the leaves of *R. cubensis* and some populations of *R. mariana*. However, in most cases, the degree of folding is probably due to diurnal and seasonal changes in temperature, relative humidity, illumination, and other environmental factors. The age of the leaf probably also affects the degree of folding. It may be said, however, that the leaves of *Rhexia alifanus* are always flattened and that the leaves of the remaining taxa exhibit varying degrees of folding.

Holm (1907), Solreder (1908), and Metcalfe and Chalk (1950) have reported the presence of crystal aggregates of calcium oxalate in various organs of members of the Melastomataceae. Holm reported their presence in the leaves and stem of *Rhexia virginica* and their absence in the same organs of *R. mariana*. The crystal aggregates, when present, are located in the spongy mesophyll of the leaf and in the epidermis, wings, and pith of the stem. In the leaf, the crystals are associated with vein endings, but in *R. aristosa* there is a much greater concentration of crystal aggregates along the main vein than in other areas of the leaf. Crystal aggregates are present in *R. nuttallii*, *R. alifanus*, *R. aristosa*, *R. nashii*, *R. mariana* (but not in all populations), *R. mariana* var. *interior*, *R. mariana* var. *ventricosa*, *R. virginica*, and *R. salicifolia*. They are absent in the other species and in some populations of *R. mariana*.

Inflorescence. The inflorescence of *Rhexia* is cymose, fundamentally a simple or compound dichasium. It is most greatly reduced in *R. petiolata* and *R. nuttallii*, in which the flowers may actually be solitary and ranges (this usually based on the vigour of the plant) to a diffuse system. Branching within such a system is often dichotomous, two lateral branches developing at the base of each central flower and these in turn terminating in a simple dichasium of three flowers or again branching. In some examples the inner branches of a particular dichotomy may abort or be reduced, hence parts of the inflorescence may assume a secund-racemose aspect (see illustrations). Bracts arise from most of the nodes of the inflorescence, the lowermost of these resembling upper stem leaves, the ones directly subtending flowers often much reduced or even scale-like (in the case of *R. alifanus* they are scale-like and early deciduous).

Flowers. The flowers of *Rhexia* are, save for the androecium, actinomorphic, either subsessile or at least produced on pedicels shorter than the calyx. According to Eyde and Teeri (1967) who made detailed observations of the floral anatomy of *R. virginica*, the tissues of the prominent hypanthium are fused to all but the uppermost (beaked) portion of the ovary wall, hence the ovary is definitely inferior. This is in agreement with the observations

of Fernald (1950) and James (l.c.) but not with those made by Gleason and Cronquist (1963). The cause for such conflicting observations, Eyde and Teeri state, is the fact that during maturation of the fruit cell layers in the fruit wall separate prior to dehiscence so that the partly inferior ovary appears superior. The hypanthium itself is oblong-cylindrical in the bud becoming flask-shaped at maturity, being divided into a tubular neck, from which the four calyx lobes spread and a globose or subglobose body which itself encloses the capsule. The calyx lobes range from broadly to narrowly triangular and are usually spreading at time of anthesis and on the fruiting hypanthium.

The four petals of *Rhexia* are convolute in the bud, when expanded broadly oblong, obovate, or even suborbicular, the bases oblique. Venation of the petals is delicate but distinct, the larger veins several, simple and slightly spreading at the petal base, finely branched distally. If one takes a "face-on" view of a flower it is seen that the central vein of a petal extends more or less diagonally across the broad blade, and is usually excurrent as a short to quite prominent slender trichome. Hence, because the blade itself is asymmetric, the midvein does not bisect it. The side of the blade to the left of the midnerve has much less area and is more gently curved than is the side of the blade to the right which is much more strongly curved, particularly distally, and the apex of which comprises most of the petal tip. In some species of *Rhexia* (e.g. *R. nashii*) a portion of the petal back is trichomiferous; such trichomes appear on that part of the corolla that is exposed in the bud, that part correlating with the narrower, "left" hand, portion of the blade. In all *Rhexia* the petals are fairly quickly deciduous, those of *R. nuttallii*, *R. petiolata* and *R. lutea* lasting not much more than a day and those of the remainder of the species usually expanding in the early hours of the morning and being shed by afternoon. In *R. nuttallii*, *R. lutea* and *R. petiolata* the expanded, upper surface of the petal blade is concave and the petals at anthesis are curved tongue-like and also somewhat ascending; in the rest of the species the petals at anthesis spread horizontally from the hypanthium and are plane.

Anthers. According to James and Eyde and Teeri (l.c.) the eight stamens of *Rhexia* in the bud are bent inward with their tips inserted into shallow pockets around the upper part of the ovary. The anthers as anthesis approaches are twisted on their filaments in a counterclockwise fashion, all being brought into a roughly parallel position toward the lower part of the open flower and with their apices directed outward and downward. The anther itself is four-locular in its early stages of development, but through a breakdown of the septa it becomes unilocular at anthesis; pollen is shed through a solitary, circular, apical pore.

Gynoecium and fruit. The gynoecium of *Rhexia* is comprised of a mostly inferior, four-locular ovary tipped by a single linear style. The stigma is truncate. The placentation of the numerous ovules is axile. The fruit, which develops is a loculicidal capsule which remains enclosed within the hypanthial body.

Seed. All species but *R. alifanus* have cochleate seed whose surfaces are marked with concentrically oriented, regular or irregular ridges of tubercles, papillae or laterally-flattened, domelike projections. The seed of *R. alifanus* is itself larger, roughly triangular in outline with a smoothish surface. Sculpturing of seed of many of the species, particularly *R. mariana* var. *mariana R. nashii*, and *R. virginica* is quite variable. Our own drawings are merely attempts to portray some of the commoner forms of sculpture; thus, in regard to seed, drawings have great limitations.

CYTOLOGY

1. *Chromosome numbers.* Chromosome preparations of all *Rhexia* species were made by fixing buds in the field in 3 absolute ethanol: 1 glacial acetic acid. Microspore parent cells were observed by squashing and staining with aceto-carmine. Voucher specimens are deposited in the following herbaria: EU, NCU, and VDB.

The base or "X" chromosome number for the genus *Rhexia* is eleven. No departures from this base number or multiples thereof were observed. Chromosome counts were consistent within a population. All cells observed from plants of the same species population had the same number of chromosomes. In several taxa, the number varied from population to population (polyploidy). No meiotic irregularities were observed in any of the preparations.

Chromosome counts for plants of the various *Rhexia* taxa are presented in Table I.

There are polyploid series in *R. cubensis*, *R. nashii*, *R. mariana*, and *R. virginica*; and there are polyploid taxa without any extant or known diploid relatives within those taxa (*R. lutea*, *R. nashii*). All ploidy levels in *R. cubensis* were found within a three county area on the Florida panhandle.

No morphological differences could be detected between diploid and polyploid plants of any of the taxa, although there were often slight chromatographic differences.

The chromosome number of *Rhexia alifanus* is not distinctive, but the size of the chromosomes is. As previously figured (Bostick, 1965), the metaphase chromosomes of *R. alifanus* are much larger than the metaphase chromosomes of *R. mariana*. This is also true when the chromosomes of *R. alifanus* are compared to those of the other taxa of the genus.

2. *Pollen.* Pollen from dried specimens was used in the study of pollen morphology and size. Pollen from a single anther from each population studied was scraped onto a slide, drenched with absolute ethanol and mounted in methylene blue in glycerine jelly. One hundred grains from each population were measured. Scores of pollen size of five populations of each taxon were combined (with the exception of *R. parviflora*, where only two populations were sampled).

The tetrad arrangement in all taxa of the genus is of the tetrahedral system. The pollen grains' morphology is consistent with that described for the Melastomataceae by Erdtman (1952) in that the grains are spheroidal and

TABLE I

CHROMOSOME NUMBERS IN *RHEXIA*.

Unless otherwise stated, collection numbers are those of the junior author. Localities are given by county and state.

Taxon	*n*	*Collection no. and locality*
R. petiolata Walt.	11	332-1, Duplin, N.C.; 343-2, Brantley, Ga.; 346-2, Clay, Fla.; 372-3, Franklin, Fla.; 359-1, Hillsborough, Fla.
R. nuttallii James	11	343-1, Brantley, Ga.; 348-2, Clay, Fla.; 353-2, Indian River, Fla.; 396-1, Walton, Fla.
R. lutea Walt.	22	412-2, Lee, N.C.; 392-2, Franklin, Fla.; 378-1, Jackson, Miss.
R. salicifolia K & B	11	400-1, Bay, Fla.; 398-2, Walton, Fla.
R. parviflora Chapm.	11	391-1, Franklin, Fla.; 393-1, Franklin, Fla.
R. aristosa Britt.	11	185-1, Princess Anne, Va.; 337-1, Bladen, N.C.; 384-1, Barbour, Ala.
R. virginica L.	11	338-1, Bladen, N.C.; 439-1, Wilson, N.C.; Clark 1953, Marion, Tenn.; 403-3, Clinch, Ga.; 342-2, Wayne, Ga.; 346-3, Clay, Fla.
	22	331-1, Duplin, N.C.; 435-1, Wake, N.C.; 418-1, Fayette, Tenn.; 374-2, Tuscaloosa, Ala.; 377-2, Choctaw, Ala.; 342-1, Wayne, Ga.; 346-2, Clay, Fla.
R. mariana L. var. *interior* (Pennell) Kral & Bostick	22	417-1, Hardeman, Tenn.; 424-1, Benton, Ark.
R. mariana L. var. *ventricosa* (Fern. & *Grisc.*) Kral & Bostick	22	444-1, Dinwiddie, Va.; 443-1, Nash, N.C.; 438-1, Wilson, N.C.
R. mariana L.	11	405-2, Jasper, S.C.; 341-1, Long, Ga.; 386-2, Miller, Ga.; 389-1, Franklin, Fla.; 359-1, Hardee, Fla.; 399-1, Walton, Fla.; 380-1, Morehouse, La.; 421-1, White, Ark.; 422-1, Faulkner, Ark.
R. cubensis Griseb.	11	350-1, Putnam, Fla.; 368-3, Franklin, Fla.
	22	388-1, Franklin, Fla.
	33	406-1, Berkeley, S.C.; 395-1, Bay, Fla.; 398-1, Walton, Fla.
R. nashii Small	22	180-1, Harnett, N.C.; 329-1, Orange, N.C.; Wilson, N.C.; 345-1, Union, Fla.
	33	330-1, Duplin, N.C.; 369-1, Franklin, Fla.; 356-1, Highlands, Fla.
R. alifanus Walt.	11	412-3, Lee, N.C.; 123-5, Bladen, N.C.; 405-1, Jasper, S.C.; 387-1, Grady, Ga.; 346-1, Clay, Fla.; 392-1, Franklin, Fla.

tricolpate with three additional pseudocolpi. The colpi in *Rhexia* and in the other members of the family each contains a single germinal pore. The exine is characterized by the presence of six darkly-staining, thickened ridges which are adjacent to each colpus and pseudocolpus. Pollen morphology is the same in all taxa of the genus; and the only interspecific difference to be found in the pollen grains is in their diameters.

The pollen size range for the entire genus is quite narrow (16-33 micra); and the interspecific differences are so narrow that no species may be separated from any of the others on the basis of pollen grain diameter. There is a rather vague correlation between ploidy level and pollen grain diameter. Polyploids tend to have the largest pollen, although this trend is weakened by the relatively small pollen of the tetraploids of *Rhexia lutea*, *R. nashii*, and *R. mariana*. It is to be expected that there should be a correlation between ploidy level and cell size, since an increase in chromatin should be accompanied by an increase in cytoplasm with a corresponding increase in cell volume.

TAXONOMIC TREATMENT

Some special problems in identification of Rhexia. The treatment which follows should be used with the following qualifications:

(1.) In this treatment, as in preceding treatments, much use is made of relative width and character of the pairs of stem faces. As was already mentioned there is one group made up of such taxa as *R. virginica*, *R. mariana* var. *interior*, *R. mariana* var. *ventricosa*, *R. parviflora*, *R. salicifolia*, and *R. aristosa* in which the faces at mid-stem are subequal while in the rest of the species one pair of stem faces is narrower and concave, the other slightly convex and broader. This difference, however real, is hardest to apply to herbarium material where some stem character is lost through pressing of the specimens. In fact, identification becomes involved with gaining, through experience of examining many specimens, a concept of the relative "squareness" or "roundness" of the stem in cross section. This contrasting character is best observed in the middle and upper internodes of the main axis of a stem.

(2.) Shape of the mature hypanthium is a critical diagnostic feature of *Rhexia* species. Of particular importance is the length of the body of the hypanthium in relation to the length of the hypanthial neck. Total length of hypanthium in our work is a measure from the point of attachment of pedicel to body to hypanthial rim. Thus the length of the calyx lobes is not included. The body of the *Rhexia* hypanthium is usually globose, but can range to ovoid or depressed-globose. In any event, the shape of the hypanthial body is determined, its length measured, and a measurement is taken from the tip of this body outline to the rim of the hypanthium in order to get the neck length. The neck of the hypanthium is definitely longer than the body in *R. aristosa*, *R. nashii*, *R. cubensis*, *R. mariana* var. *ventricosa*, *R. mariana* var. *interior*; usually it is shorter than the body in *R. virginica*, *R. salicifolia*, southern forms of *R. mariana* var. *mariana*, *R. nuttallii*, *R.*

lutea, *R. petiolata*, *R. parviflora*. It is quite variable in northern and western forms of *R. mariana* var. *mariana*.

(3.) Unless otherwise indicated, leaf characters are drawn from mid-cauline leaves.

RHEXIA L., Sp. Pl. 346. 1753.

Alifanus Pluk. ex Adans. Fam. Pl. 2: 234. 1763.

Erect, sometimes woody-based, perennial herbs from woody, ascending caudices, narrow rhizomes, or tubers or a combination of rhizomes and tubers. Stems hirsute and/or glandular-hairy (except for *R. alifanus*), usually 4-angled above the thickened woody base, the angles in some species winged. Leaves opposite, decussate, usually with three main veins, the venation arcuate, petiolate or sessile, the margins serrate or serrate and ciliate, the apices characteristically acute. Inflorescence cymose, the flowers few to many, slightly zygomorphic. Bracts consistent with the shape of the leaves but much smaller, often deciduous. Receptacle elevated, forming with the perianth base a two-layered, urceolate, hypanthium the inner layer of which bears stamens and petals at its tubular apex with the outer layer producing triangular calyx lobes. Sepals four, the calyx lobes usually narrowly triangular, flaring or ascending, acute or aristate. Petals four, distinct, the blades asymmetrical, oblique, ascending, or horizontally spreading at anthesis, lavender, pink, white or (in one species) yellow, broad, convolute in the bud, the apices broadly rounded or truncate, and with the mid-vein excurrent as a slender multicellular hair, the margins entire, the bases short-clawed, the surfaces smooth above, but in some species bearing glandular hairs beneath on that area exposed in the bud. Stamens eight, subequal, in two whorls; anthers 1-celled at anthesis, basifixed, introrse, usually well-exserted and declined toward the base of the opened flower, also oriented in a parallel fashion, yellow, linear-oblong to linear-lanceolate; dehiscence through a terminal, adaxial, pore; filament long, slender, pale, downwardly curved, with a small protuberance or hook-like appendage at its point of juncture with the anther. Carpels four, fused into a four-locular gynoecium which terminates in a single, slightly sigmoid or curved, button-tipped, style. Placentation axile, the ovules numerous, on massive placenta. Fruit capsular, enveloped closely by the hypanthial body, and with a loculicidal, somewhat irregular, dehiscence. Seeds curvate, commonly cochleate (shaped like a snail shell), small. Seed coat pebbled, ridged, tubercled or smooth.

A genus common to moist, acid, sandy or peaty situations such as bogs, ditches, savannas and pine flatwoods, centering in the southeastern United States but extending as one species north into eastern Canada and as one species southward into the Caribbean islands.

Type species: *Rhexia virginica* L.

A KEY TO RHEXIA

1. Plants with woody, stout, ascending caudices or taproots; anthers short, at anthesis seldom longer than 2 mm., almost straight; petals at anthesis

ascending, definitely not horizontally spreading or plane.

2. Leaves predominently of an ovate type; plants sparingly branched; internodes smooth; flowers, later fruit, partly concealed by closely subtending bracts similar in shape to stem leaves and but little smaller; mid-portion of stems angled.
   3. Teeth of leaf margins at mid-leaf usually drawn out into hairs 1 mm. long or slightly longer; sepal lobes acuminate-aristate; hypanthium smooth save for a few hairs at and between the sepal tips; seed with a pebbled surface . . . . . 1. *R. petiolata* Walt.
   3. Teeth of leaf margins at mid-leaf blunt or, if terminating in a hair, the hair shorter than 1 mm.; mid-portion of stems flattened or ridged but not angled; hypanthium glandular-hairy, the sepal tips blunt or acute, but definitely not acuminate; seed ridged, 2. *R. nuttallii* James
2. Leaves predominantly of an oblong, linear or spatulate type; plants usually bushy; petals yellow, the flowers and fruit not concealed as above; internodes with at least a scattering of hairs. 3. *R. lutea* Walt.

1. Plants with various types of rootstocks but anthers longer, curvate; petals at anthesis horizontally spreading, plane.
   4. Stems with at least some hairs at the nodes, usually the internodes also hairy; seed cochleate (shaped like a snailshell).
      5. All 4 stem faces at mid-stem approximately equal, the stem faces almost flat, the angles sharp or winged.
         6. Leaves predominantly of a linear, spatulate, oblong or elliptical type, the blades turned to a vertical position; neck of hypanthium shorter than the body; the plants tuberiferous, rhizomatous, or both; plants of sandy margins of limesink lakes, n.w. Florida. . . . . 4. *R. salicifolia* Kral & Bostick
         6. Leaves predominantly of a lanceolate, elliptic or ovate type, the blades not oriented as above; neck of hypanthium shorter or longer than body; plants tuberiferous or rhizomatous or both, of more general distribution.
            7. Petals white; hypanthium smoothish, usually 5-7 mm. long; leaf blades at mid-stem pronouncedly petiolate; diminutive short-rhizomatous plants of swamp margins, Franklin Co., Florida. . . . . 5. *R. parviflora* Chapm.
            7. Petals lavender to lavender-rose; leaf blades at mid-stem subsessile or short petiolate; tuberiferous plants of wider range.
               8. Stem angles conspicuously winged at mid-stem; lower portion of stem usually thickened, sometime spongy; hypanthial neck rarely longer than body of hypanthium.
                  9. Hypanthial lobes flaring horizontally, aristate; area of hypanthial rim with long, stiff, yellowish, tapering, flaring trichomes; petals dull lavender . . 6. *R. aristosa* Britton
                  9. Hypanthial lobes and hairs not as above; petals bright lavender-rose. . . . . 7. *R. virginica* L.

8. Stem angles at mid-stem wingless or very narrowly winged; hypanthial neck usually longer than the body.
   10. The plants strictly rhizomatous, the internodes of stem hirsute; hairs of mature hypanthia scattered rather evenly over the surface; leaf surfaces hairy; lobes of hypanthium not flaring horizontally and not aristate, nor alternating with long, stiffly flaring trichomes; flowers bright lavender-rose.
      11. Seeds papillate, the papillae in concentric lines; plants primarily of eastern seaboard. . 9. *R. mariana* L. var. *ventricosa* (Fern. & Grisc.) Kral & Bostick
      11. Seeds irregularly ridged in concentric lines; plants primarily from west of the Mississippi River or in interior physiographic provinces. . . 10. *R. mariana* L. var. *interior* (Pennell) Kral & Bostick
   10. The plants tuberiferous, the internodes of stem smooth or smoothish; nodes only with tufts of spreading hairs; hairs of mature hypanthium crowded toward its neck and orifice, stiff, flaring, yellowish, some as long as the calyx lobes; lobes of hypanthium aristate, flaring horizontally; flowers large, dull-lavender. . . . . 6. *R. aristosa* Britton
5. All four stem faces not even approximately equal, one pair of opposing faces broader, darker green, convex, the narrower pair paler, concave (thus the stems having a more cylindrical appearance at mid-stem).
   12. Flowers white; lower and mid-cauline leaves ovate to ovate-lanceolate.
      13. Bracts elliptic or broader, often nearly as broad as the hypanthia they subtend, giving mature inflorescence a "leafy" look; petals suborbicular; plants short-rhizomatous; edges of cypress or titi swamps, Franklin Co., Florida. 5. *R. parviflora* Chapm.
      13. Bracts linear or narrowly triangular, definitely narrower than the hypanthia they subtend and giving the mature inflorescence a more naked look; petals narrower; plants long-rhizomatous, usually on drier substrata and of much wider distribution. . . . . 8. *R. mariana* L. var. *mariana*
   12. Flowers white or lavender or rose; lower and mid-cauline leaves linear, oblong, lanceolate or spatulate.
      14. Leaves predominantly of a linear, oblong or spatulate shape; hypanthium at maturity 1 cm. or longer, with a scattering of gland-tipped hairs; plants both rhizomatous and tuberiferous; petals bright lavender-rose; commonly of lower, sandier portions of the Atlantic and Gulf Coastal Plain. . . 11. *R. cubensis* Griseb.
      14. Leaves various, but if leaves linear, the hypanthium shorter, smoother, and the petals smaller.
         15. Hypanthium smooth, 1 cm. long or more at maturity; leaves

at mid-stem predominantly lanceolate or narrowly ovate; plants occasionally tuberiferous, always rhizomatous; exposed petal parts of buds with at least a scattering of glandular hairs; petals large, dull-lavender. . . 12. *R. nashii* Small

15. Hypanthium with at least some hairs, usually shorter; plants exclusively rhizomatous; exposed petal backs of bud smooth; petals smaller, ranging from white to pale lavender, rarely bright lavender. . . . 8. *R. mariana* L. var. *mariana*

4. Stems smooth, even at the nodes; tall, wand-like, bright rose-flowered plants of open pine barrens, the hypanthia usually copiously glandular-hairy; seed wedge-shaped. . . . . 13. *R. alifanus* Walt.

1. RHEXIA PETIOLATA Walt., Fl. Carol. 130. 1788. (Fig. 1, p. 420; map, p. 437.)

Rhexia ciliosa Michx., Fl. Bor.-Am. 1: 221. 1803.

Low, smoothish, perennials from short, stocky, caudices. Shoots solitary or several, 1-5 dm. tall, rigid, sparingly branched or simple, angular, brownish and with a thin, slightly exfoliating bark below, upwardly becoming tan or reddish-brown, smooth or with a few hairs at the nodes. Leaves predominantly ovate to suborbicular, the larger ones 1.0-1.5 cm. long (rarely 2 cm. long), ascending, short-petiolate, the surfaces usually smooth, the apex acute to acuminate or bristle-tipped, the margins serrulate, the ascending tips of the teeth terminating in conspicuous hairs, thus imparting a ciliate look to the blade margin. Basal leaves broadest, usually shorter than those of the mid-stem into which they gradually grade, upwardly gradually grading into the bracteal leaves which are similar in shape and size to upper stem leaves and which usually partly conceal the flower bases, later the fruit. Inflorescence a few-flowered, but generally congested, leafy cyme. Petals slightly asymmetrical, broadly oblong, elliptic or ovate, to 2 cm. long, lavender-rose, glabrous, remaining somewhat involute at anthesis, never horizontally spreading. Anthers ca. 2 mm. long, on filaments up to 4 mm. long, but usually shorter. Mature hypanthium 5-7 (-9) mm. long, smooth save for a few elongate hairs around the rim and on the sepal lobes, the body globose or depressed-globose, abruptly contracting into the short-cylindrical base of the neck which in turn flares into a broadly spreading orifice whose lobes are narrowly triangular-acuminate and which are tipped by elongate tapering yet fairly stiff, hairs. Seeds ca. 0.6 mm. long, cochleate, the surface usually pebbled, or covered with numerous, short ridges of dome-shaped processes.

Moist acid sands and sandy peats of bogs in pine flatwoods, savannas, and rights-of-way, Coastal Plain, southeast Virginia south into peninsular Florida west into eastern Texas. Chromosomes: N equals 11.

Type: "Rhexia 723," Walter Herbarium at BM. James states that the type is fragmentary, but the species can be identified from the type description, however brief.

2. RHEXIA NUTTALLII James, Brittonia 8: 214. figs. 1, 17. 1956. (Fig. 2, p. 421; map, p. 438.)

R. serrulata Nutt., Gen. 1: 243, 1818, non Rich. in Bonpl. Rhex. 74, pl. 28. 1813.

Low, smoothish perennials from short, stocky, caudices. Shoots solitary or several, 1-3 (-4) dm. tall, rigid, sparingly branched or simple, subterete, brownish and with a thin, sometimes exfoliating bark toward the base, upwardly becoming greenish-brown or reddish-brown or tan, usually smooth. Leaves predominantly ovate to suborbicular, the larger ones 1.0-1.5 cm. long, the surfaces smoothish, dark yellow-green above and paler green or maroon beneath, the apex obtuse to acute, the margins subentire to serrulate. Basal leaves broadest and with the longest (to 1.5 mm.) petioles, gradually lengthening toward mid-stem, thence gradually grading into the bracteal leaves which are of similar shape and often nearly as large. Inflorescence a sparse-flowered, usually regular, cyme, with the flowers and young hypanthia partly concealed by subtending bracts. Petals slightly asymmetrical, broadly cuneate or obovate, 1.0-1.2 cm. long, lavender-rose, at anthesis slightly spreading but certainly not flaring horizontally, the blades somewhat involute, the mid-vein excurrent as a short hair, the petal backs with at least some gland-tipped hairs. Mature hypanthium 0.5-0.7 cm. long, glandular-hairy, brownish, almost woody in appearance, on stout pedicels to 3 mm. long, the hypanthial body globose or depressed-globose, abruptly narrowing to a very constricted, short neck with flares into an orifice fully as broad as the hypanthial body; hypanthial lobes deltoid, the tips usually obtuse or blunt. Anthers at anthesis short-linear, about 2 mm. long, straight, on filaments to 3.5 mm. long. Capsule smooth, depressed-globose. Seeds ca. 0.6 mm. long, cochleate, the crest marked with irregular lines of laterally compressed, dome-shaped, processes. Chromosomes: N equals 11.

Sandy peat of pine flatwoods bogs, southern Georgia and throughout Florida.

Type: "Georgia," Baldwin (Nuttall 220). At PH. Isotype at NY seen.

Remarks: This well-marked species is one of the rarest in collections, probably because its small size makes it an insignificant element among other flatwoods plants. However, it is fairly abundant in the pine-saw palmetto flatwoods of peninsular Florida, and shows weedy tendencies on bulldozed, yet still moist sandy soils there. *R. petiolata* Walt. is quite similar to it in habit and flower and is common in the same localities but no natural hybrids between the two have ever been reported.

3. RHEXIA LUTEA Walt., Fl. Carol. 130. 1788. (Fig. 3, p. 432; map, p. 437.)

Stiffly branching perennial, several rigid shoots arising from a thickened, caudex or taproot. Shoots seldom longer than 4 dm., hirsute with spreading hairs, the lower portion of the stem usually reddish-brown, subterete, sometimes developing a thin tight smooth bark, the mid and upper portion of the stem somewhat four-angled (rarely low-winged as well), the intervening faces flat or convex. Leaves (obovate-) spatulate to elliptic or narrowly

oblanceolate, all but the lowermost subsessile, the larger ones 2-3 cm. long, dark yellowish-green above, paler beneath and evidently triple-nerved with the two lateral nerves very close to the margin on narrower leaves; leaf surfaces with slender but stiff, usually appressed, yellowish trichomes; leaf apex acute, obtuse, rounded, or mucronate; leaf margin subentire to, more frequently, distantly low-serrate, the teeth closely ascending, often terminating in slender hairs. Leaves lengthening and narrowing up to the area of mid-stem, thence gradually reducing into the bracts of the inflorescence; leaves of branches of the main axis invariably much shorter and narrower and from shorter internodes. Inflorescence a regularly branched often dichotomous cyme, frequently quite congested and made quite leafy by the persistent bracts. Petals obovate to broadly cuneate, 1.0-1.5 cm. long, yellow, ascending in the flower at anthesis, but definitely not spreading horizontally, smooth save for the hair-like projection of the midvein. Anthers at anthesis short-linear, ca. 2 mm. long on filaments up to 5 mm. long; style at anthesis little longer than the stamens. Mature hypanthium 6-7 mm. long on a stout pedicel 1-2 mm. long; hypanthial body globose, abruptly contracting into a short-cylindrical lower neck which in turn flares into a campanulate upper neck, the whole neck slightly shorter than the body. Sepal lobes narrowly triangular, aristate. Hypanthial hairs long, spreading, usually confined to the neck and to the sepal lobes. Capsule smooth, globose but for a slender apex. Seed cochleate, ca. 0.7 mm. long, with a few straight ridges of papillae along the crest, the sides with lower, more scattered papillae or smoothish. Chromosomes: N equals 22.

Sandy peat or sandy clay peat of pine flatwoods, savannas, hillside seepage areas and bogs, Coastal Plain, eastern North Carolina south into northern Florida and west into eastern Texas.

Neotype: moist ditch near pond with Nyssa, 2.3 mi. w. St. Stephen, Berkeley Co., South Carolina, *James 678.* (At GH).

Remarks: This species, with its unique hypanthial shape and yellow flowers, is too well marked to invite much further comment. Like *R. alifanus*, it shuns lower peninsular Florida. Actually it is most abundant west of Florida in southern Alabama, Mississippi, southern Louisiana and southeastern Texas. There it is often common in *Sarracenia* bogs and savannas.

4. RHEXIA **salicifolia** Kral & Bostick, sp. nov. (Fig. 4, p. 423; map, p. 438.)

Planta humilis (ca. 20 cm., raro ad 55 cm. alta) caule glanduloso-hirsuto faciebus superioribus aequalibus, radicibus tuberiferis, non-stoloniferа. Folia angusta elliptica vel linearia vel oblanceolata 1—5 mm. lata 15—40 mm. longa. Antherarum appendicula 0.25 mm. longa.

Plant usually low (ca. 20 cm., rarely to 55 cm.), rigid, often bushy, tuberiferous, non-stoloniferous, glandular-hirsute. Primary axis subligneous and terete below with a thin, longitudinally flaking, cinnamon or tan bark, above four-angled, narrowly four-winged, and glandular-hairy, the faces of the stem subequal. Leaves narrowly elliptic, oblanceolate, or linear, 1.5-4.0 cm. long, 1.0-5.0 mm. broad, sessile, three-nerved with the lateral nerves often

faint and extending little more than half the length of the blade or, on narrower leaves, absent. Upper and lower surfaces of the leaves sparsely to copiously glandular-hirsute, the margins with distant, low, ascending denticles, these produced into ascending, glandular hairs. Leaves with bases acute to cuneate; leaf apex acute, usually tipped by a glandular hair. Inflorescence a densely to sparsely flowered cyme. Mature hypanthium (4.0-) 5.0-7.0 (8.0) mm. long, 3.5-5.0 mm. broad, the neck shorter than the globose body, greenish-maroon, with a scattering of glandular hairs. Calyx lobes narrowly triangular, 1.5-2.0 mm. long, spreading to ascending. Petals broadly obovate or suborbicular, 11.0-12.0 mm. long, 7.0-9.0 mm. broad, deep lavender-rose, smooth above, glandular-hairy beneath, at least in the bud. Anthers 4.0-5.0 mm. long, appendage 0.25 mm. long. Capsules subglobose or broadly ovoid, 4.0-5.0 mm. long, 3.5-4.5 mm. wide, with short, glandular hairs at the summit around the style base. Seeds cochleate, 0.7-0.75 mm. long 0.5-0.55 mm. broad, 0.3-0.35 mm. thick with 3 to 5 prominent, broad, symmetrical or vermiculate longitudinal ridges or contiguous domelike tubercles in lines, these most prominent on the crest. Chromosomes: N equals 11.

Sandy shores of limesink lakes and interdune swales along the seacoast, northwestern Florida.

Type: FLORIDA. BAY CO.: shores of Merial Lake, along Fla. Rt. 77, w.n.w. Vicksburg, *R. K. Godfrey* and *R. D. Houk 61554*. Holotype at FSU.

Remarks: There is some overlap of characteristics between *R. salicifolia* and two other tuberiferous *Rhexia*, *R. cubensis* and *R. virginica*. It resembles the former in the glandular character of its indument, in its narrow leaves, and in habit. On the other hand it suggests *R. virginica* in size and shape of hypanthium as well as in having the faces of its stems approximately equal. Comparative distinguishing features are given in tabular form below:

	R. virginica (21 localities)	*R. salicifolia* (4 localities)	*R. cubensis* (36 localities)
Stem:	4.2-11.0 dm. long, alate, faces equal; trichomes sparse, gland-tipped.	2.0-5.5 dm. long, narrowly alate, faces equal; trichomes copious, gland-tipped.	3.0-6.0 dm. long, not alate, the faces unequal; trichomes gland-tipped.
Leaves:	lanceolate or lance-ovate, (3.0-) 5.0-7.0 cm. long, (0.7-) 1.0-2.2 cm. broad, usually ascending, margin conspicuously serrate; trichomes non-glandular.	narrowly elliptic, linear or linear-oblanceolate, 1.5-4.0 cm. long, 0.1-0.5 cm. broad, often spreading, margin denticulate or entire; trichomes gland-tipped, not confined to margin and veins.	narrowly elliptic, linear, or linear-oblanceolate, 1.9-5.0 cm. long, 0.1-0.5 cm. broad, often spreading, the margin serrate; trichomes not gland-tipped, confined except in very broadest leaves to margin and midrib.
Branches:	Usually sparse, mainly from upper nodes.	Frequent, often from most of the nodes of the primary axis.	Frequent, often from most of the nodes of the primary axis.

Hypanthium:	6.0-7.0 mm. long, the neck shorter than the body; smooth to very sparingly glandular-hairy.	5.0-7.0 mm. long, the neck shorter than the body; sparsely to copiously glandular-hairy.	10.0-15.0 mm. long, the neck as long as or longer than the body; glandular-hairy.
Petals:	1.0-1.5 (-1.8) cm. long, deep lavender rose.	1.1-1.2 cm. long, lavender-rose.	1.7-2.0 cm. long, pale to deep lavender or rose.
Anthers:	5.0-6.0 mm. long, appendage ca. 0.5 mm. long.	4.0-5.0 mm. long, appendage ca. 0.25 mm. long.	8.0-11.0 mm. long, appendage 1.0-3.0 mm. long.
Seeds:	0.5-0.7 mm. long, 0.4-0.5 mm. broad, 0.25-0.3 mm. thick; tubercles dome like, in lines or irregularly formed, or surface papillate.	ca. 0.5 mm. long, 0.4-0.5 mm. broad, 0.3 mm. thick, coarsely tuberculate or with the broad narrow tubercles contiguous to form ridges.	0.6-0.7 mm. long, 0.5-0.6 mm. broad, 0.25-0.30 mm. thick, the tubercles contiguous or usually joined to form several longitudinal, narrow prominent ridges.

The above measures are from population samples ranging from 10 to 50 individuals per population.

The only other species of *Rhexia* which we have observed in association with *R. salicifolia* are *R. mariana* and *R. cubensis*. In the type locality, the flowers of *R. mariana* are uniformly white and the plants occupy higher ground than does *R. salicifolia*. In the area of Dog Lake (Dog Lake Recreational Area, s. of Tallahassee in Apalachicola National Forest, *R. Kral & R. K. Godfrey 15584*), *R. salicifolia* and *R. mariana* var. *mariana* grow in a mixed population along the shore of the lake; here the flowers of *R. mariana* are pinkish. A sample of 35 specimens all of which at first appeared to be *R. salicifolia* was taken from this locality and a seed mount made of each specimen. Four of the seed mounts showed the more finely tuberculate surface character of seed of *R. mariana* and these seed were intermediate in size between the two species. The specimens from which these four samples came were re-examined and these showed intermediate character of habit, foliage, and hypanthium. It was also evident that the capsules of the morphological intermediates had very few perfect seeds, while those of the putative parents from the same area were, on checking, filled with seed. Therefore we are of the opinion that some hybridization between *R. mariana* and *R. salicifolia* is presently occurring. In two localities near the coast of the Florida panhandle (Bay Co.: *Kral 17740*; Walton Co.: *Kral 17745*) populations of *R. cubensis* are mixed with *R. salicifolia* but though thousands of individuals of both species were present at the time of collection no evidence of hybrids was seen.

Dr. Godfrey, to whom we owe the first known collections of this species, sent material of *R. salicifolia* to Dr. James, who was of the opinion that this taxon could perhaps have been of hybrid origin between *R. cubensis* and *R. virginica*. Certainly, as the chart shows, there are several resemblances to both species. However, we have not yet found populations of *R. virginica* cohabiting the areas in which *R. salicifolia* occurs nor have we yet found

hybrids between *R. cubensis* and *R. virginica* in those few cases of mixed populations of the two; neither have such hybrids been synthesized as yet.

5. RHEXIA PARVIFLORA Chapm., Fl. ed. 3. 156. 1897. (Fig. 5, p. 424; map, p. 438.)

Low, sparingly to copiously branched, perennials from a system of short, stoloniferous rhizomes. Stems up to 4 dm. tall, the lower part somewhat woody, pale brown, usually 4-angled, at mid-stem definitely angled (sometimes with low wings as well) and the stem faces subequal, sparingly hairy or smooth save for the nodes. The larger leaves from broadly ovate to elliptic, to 3 cm. long, petiolate, the petioles up to 0.5 cm. long, sparsely, usually appressed, pubescent, the apex and base acute, the margin serrulate, the ascending teeth hair-tipped. Basal leaves usually broadest, these sometimes suborbicular, thence grading gradually into narrower but longer blades, thence gradually into bracteal leaves. Inflorescence a regularly branched, sparsely flowered, cyme. Bracts of the inflorescence similar in shape to the stem leaves, imparting to it a "leafy" look. Petals asymmetrical, suborbicular to broadly obovate, to 1.3 cm. long but usually closer to 1 cm. long, white (very rarely pale lavender), the mid-vein excurrent as a hair, the surfaces smooth. Anthers 3.0-3.5 mm. long, linear-oblong, very slightly curvate, on filaments usually shorter. Mature hypanthium 5-7 mm. long, the body subglobose, smooth, the neck short-cylindrical, shorter than the body, and with a few hairs toward the orifice. Sepal lobes ca. 2 mm. long, triangular-acuminate. Capsule smooth, subglobose. Seeds ca. 0.6 mm. long, cochleate, crested with irregular, but roughly concentric, interrupted lines of laterally flattened, dome-shaped processes, these in turn vertically grooved. Chromosomes: N equals 11.

Sunny areas or in semi-shade, on wet sands or sandy peats of cypress pondbanks, titi swamps, and Hypericum ponds, Franklin Co., Florida (quite possibly in Liberty County as well).

Type: Apalachicola, Franklin Co., Florida, *A. W. Chapman*, 1896. At MO.

Remarks: This is perhaps the rarest of the Rhexias, another of the many surprises which Dr. Chapman turned up from the swamp country around Apalachicola. It is indeed similar to white-flowered *R. mariana* var. *mariana*, and populations of that entity are always nearby. Yet is is a different looking plant, with its characteristically shorter rhizomes, smoother stems, broader leaves (*R. mariana* var. *mariana* in this area is narrow-leaved), shorter, broader petals and shorter anthers. Strangely enough, its epidermal character is closest of all to that of *R. aristosa*, another rare but much different species.

Three rather large samples of *R. parviflora* (*Kral & Godfrey 15050*, *Kral 15702*, and *Kral 17784*), gotten from Franklin County, Florida recently have been distributed. One will note from the label information that the habitat these plants are in is quite different than that of *R. mariana* var. *mariana*. The latter is very weedy and abounds on much drier substrates. In fact, the access road to the area in which *R. parviflora* occurs has abundant patches

of *R. mariana* on its sandy shoulders, while *R. parviflora* appears to stay on the wetter soils through which the road passes. Winter leaves of both species both may be broad, but while the leaves of north Florida populations of *R. mariana* tend to lengthen and narrow, sometimes even become filiform, the summer leaves of *R. parviflora* show no such extreme. Therefore, if the difference distinguishing *R. parviflora* from white-flowered extremes of *R. mariana* var. *mariana* are few, they appear to be consistent. It is remarkable that this little plant, with a wealth of what looks to be similar habitat in north Florida and Georgia, is so restricted in known range. The niche it occupies must be extremely refined.

6. RHEXIA ARISTOSA Britton, Bull. Torrey Club 17: 14, pl. 99. 1890. (Fig. 6, p. 425; map, p. 438.)

Stiff, sparingly or profusely branched, perennials from a spongy, usually tuberiferous base. Shoots 4-7 dm. long, thickened, sometimes spongy and flaky barked and subterete toward the base, becoming tan or green and subequally four-sided at midstem, the stem angles darker green than the faces, and sometimes produced into low wings. Surface of stem glabrous save for a few long, flaring yellowish trichomes at the leafy nodes. Leaves predominantly lanceolate, ascending, the longest 2-3 cm. long, 3-5 mm. broad, pale green, the lower surfaces smooth to sparingly appressed-hairy and prominently triple-veined, the upper surfaces similarly smooth or hairy, the apex acute to obtuse, mucronate, the margin with low but regular, ascending, aristate teeth. Leaves gradually becoming longer upward into mid-stem (those of the often numerous lateral shoots noticeably smaller), and passing gradually into bracteal leaves which often closely invest the flowers, later fruit. Inflorescence most commonly a broadly paniculate cyme, branching so that the hypanthia appear to develop on the adaxial side of the major branches. Petals broadly, but asymmetrically oblong-obovate, up to 2.2 cm. long, dull lavender (similar and size and colour to *R. nashii*), the eccentric midvein excurrent as a long, tapering hair; outer surface of petals appressed-hairy, particularly toward the margins. Anthers at anthesis linear-lanceolate, curvate, 5-6 mm. long, on filaments to 8 mm. long. Mature hypanthia 7-10 mm. long on stout terete pedicels to 3 mm. long; base ovoid, tapering into a cylindrical neck of about the same length, this flaring above into the rim; sepal lobes narrowly triangular, horizontally spreading, aristate; hypanthial hairs usually restricted to hypanthial neck, rim, and lobes, stiff but slender-tapering, yellowish, the rim hairs tending also to flare horizontally. Capsule oblong-ovoid, smooth. Seeds cochleate, ca. 0.7 mm. long, irregularly but concentrically ridged with a few isolated domes or papillae. Chromosomes: N equals 11.

Peats and sandy peats of pine flatwoods bogs, cypress domes and savanna ditches, very local, New Jersey, the Carolinas, Georgia and southwestward into southeastern Alabama, always in the Coastal Plain.

Type: May's Landing, Egg Harbor City, Atlantic Co., N.J., *Kilmer & Gifford*, Aug. 1888. At NY.

Remarks: This rare plant is one of the most distinctive in the genus, with its bushy, tuberiferous, habit, its large, pale-lavender flowers, its stiffly spreading, aristate sepal lobes, and its flaring, yellowish hypanthial hairs. Its general habit and its angular stems have some overlap in character with forms of *R. virginica*, but in character of its upper epidermis (see plate) it is surprisingly like the Florida endemic *R. parviflora*.

7. RHEXIA VIRGINICA L., Sp. Pl. 346. 1753. (Fig. 7, p. 426; map, p. 438.)

R. septemnervia Walt., Fl. Carol. 130. 1788.

R. stricta Pursh, Fl. A. Sept. 1: 258. 1814. non Bonpl. Melast. II. Rhex. 19, pl. 8.

R. purshii Spreng., Syst. 5: 590 (index). 1828.

R. virginica L. var. *purshii* (Spreng.) James, Brittonia 8: 227. 1956.

Rigid, simple or sparingly branched, perennials from spongy-thickened or tuberiferous rootstocks. Shoots solitary or a few, to 1 meter tall, subterete spongy-thickened, and subterete toward the base, sometimes with a thin, reddish-brown, exfoliating bark, becoming 4-sided and wing-angled in the mid and upper portions, glandular-hairy to almost smooth save for a few hairs at the nodes. Leaves ascending, ovate to elliptic but commonly lanceolate, 3-5 (-7) cm. long, acute to acuminate, serrulate with the ascending tips of the teeth often hair-tipped, the base rounded to acute, sessile or short-petiolate. Lowermost leaves gradually shortening to the inflorescence, thence more or less abruptly reduced to much smaller bracteal leaves or scales. Inflorescence few-to-many-flowered, open or contracted, regular cyme, which has a naked appearance because of the reduced bracts. Petals asymmetrical oblong to obovate, 1.5-2.0 cm. long, lavender-rose, the midrib exserted as a glandular hair, some hairs usually also present on the petal backs. Anthers linear-curvate, ca. 5 mm. long on filaments of the same length or slightly longer. Mature hypanthium 7-10 mm. long, smooth or glandular-hairy, the body globose, gradually or abruptly contracting into a narrow neck shorter than the body, thence flaring into narrowly triangular acute to acuminate calyx lobes 3-4 mm. long. Seeds ca. 0.7 mm. long, cochleate, the surface ranging from low-muricate to papillate or tuberculate, the processes contiguous, in concentric lines and most prominent toward the crest. Chromosomes: N equals 11, 22.

Wet sands and peats of pondshores, ditches, bogs, pine flatwoods and savannas southeastern Canada south throughout almost all of the U.S.A. east of the Mississippi and westward into Texas, Missouri and Iowa.

Type: Virginia, *Clayton 227*. At BM.

Remarks: This wide-ranging species has been treated by James as comprising two varieties. The criteria employed were degree of pubescence of stem, hypanthium, bracts and petals together with lengths of calyx lobes in relation to hypanthial neck. There is some clinal change southward in the U.S.A. toward smoother plants having relatively longer calyx lobes, but both sorts of plants are found as far south as northern Florida and, as James

himself concedes, it is often difficult to know where to draw the line between the two varieties.

R. virginica often grows in close proximity to *R. mariana*, but as a rule is on moister substrata. Generally, it develops from tubers, but often produces rhizomes as well. On mucky soils it often perennates from a very stout, spongy caudex, rather than from tubers.

It is difficult to distinguish extremes of this species from *R. mariana* var. *ventricosa* or *R. mariana* var. *interior*. However, both varieties of *R. mariana* are exclusively rhizomatous, have a tendency toward longer, hairier hypanthia, and lack the broad wing-angles of the stem.

Hybrids between *R. virginica* and *R. mariana* var. *mariana* are frequently collected.

8. RHEXIA MARIANA L. var. MARIANA, Sp. Pl. 346. 1753. (Fig. 8a, p. 427; 8b, p. 428; map, p. 439.)

R. lanceolata Walt., Fl. Carol. 129. 1788.

R. mariana L. var. *rubella* Michx., Fl. Bor.-Am. 1: 221. 1803.

R. angustifolia Nutt., Gen. 1: 244. 1818. Ell., Sk. Bot. S.C. & Ga. 1: 438. 1821.

R. mariana L. var. *lanceolata* (Walt.) Wood & McCarthy, Journ. Elisha Mitchell Soc. 3: 97. 1866.

R. delicatula Small, Fl. SE. U.S. 824. 1335. 1903.

R. filiformis Small, Bull. Torrey Club 25: 468. 1898.

Hirsute, weedy perennials, forming extensive clones from shallowly set, elongate, stoloniferous rhizomes. Shoots 2-10 dm. tall, terete, the bases sometimes subligneous and with a reddish-brown, slightly exfoliating, thin bark, greenish or yellowish-green and spreading-hairy in the leafy portion, simple or freely branching from the mid-stem upwards. Leaves from linear-filiform to lanceolate, elliptic or even narrowly ovate, the longer ones mostly 2-4 cm. long, sessile or short-petiolate, sparsely to copiously appressed-hirsute, dark to pale yellow-green, the apex acute to acuminate, the margins serrulate, the teeth apiculate, or hair-tipped, the base acute to attenuate. Basal leaves usually broadest and petiolate, becoming longer and of a narrower type toward the midstem, thence gradually shortening to the base of the main inflorescence, thence abruptly replaced by small, linear, elliptic-linear, or ovate bracts. Inflorescence a few to many-flowered, open or congested cyme, the fruiting hypanthia often arranged in secund fashion toward the inside of the main branches. Petals asymmetrical, broadly cuneate, oblong or obovate, 12-15 mm. long, white to dull lavender, rarely lavender-rose, the apices often noticeably truncate-oblique, this interrupted only by the aristate excurrent mid-vein, the surfaces of the blade characteristically smooth. Anthers at anthesis linear-lanceolate, curvate, 5-8 mm. long on filaments of about the same length. Mature hypanthia 6-10 mm. long on pedicels 1-3 mm. long; hypanthial body ovoid to subglobose, more or less evenly tapering into a cylindrical or slightly upwardly expanding neck which is at least as long as the body; sepal lobes narrowly triangular, acute or acuminate, 2-3 mm.

long. Hypanthial hairs spreading, frequent to sparse, rarely absent (this most often the case in peninsular Florida forms). Capsule smooth, globose. Seed cochleate, ca. 0.7 mm. long, the surface longitudinally ridged with contiguous tubercles, papillae or laterally flattened domes, the most prominent ridges along the crest, or rarely almost smooth. Chromosomes: N equals 11, 22.

Sands, gravels, or sandy peats of pine flatwoods, bog margins, ditches, disturbed grounds, and particularly highway and railroad embankments, eastern Massachusetts south to the tip of Florida, west in the interior into the Central Lowlands and Interior Highlands, west in the Coastal Plain to Central Texas.

Type: Pluk. Almag. Bot. Mant. pl. 428. f. 1. 1700 (In part, in sensu Cogniaux, non. Walter, according to C. James, 1956).

The most difficult part of a study of *Rhexia* centers with this species. It is undoubtedly the most abundant, wide-ranging, and weediest species; it comes into contact with every other entity of *Rhexia* and hybridises with many. It often takes on several of the characteristics of other species in areas where that other species is the most abundant, and yet retains even in such cases a sufficient reservoir of individuality to mark it as *R. mariana*.

James' (l.c.) treatment stresses the existence of a white or pale-lavender flowered, narrow-leaved, small hypanthiumed variety (*R. mariana* L. var. *exalbida* Michx), and this might be held tenable on the basis of the floras of the Atlantic and eastern Gulf coastal plains. However, after examining specimens from this region in a broader context of Texas, Louisiana and southern Mississippi populations, as well as those populations of *R. mariana* from peninsular Florida, we are hard put to come to the same conclusion. As James himself states "all of the characters studied which have been used to distinguish it (*R. mariana* var. *exalbida*) from var. *mariana* are quantitative and intergradation does exists to some degree." While composite populations having narrow leaves, smooth hypanthia, smoother seed, and pale flowers are not rare, none of these features appear to vary consistently on a clinal basis. For example, as one travels west in the Gulf states, white-flowered *Rhexia mariana* with longer, hairier hypanthia and broader leaves are quite frequent; as one travels south into the peninsula of Florida, the flowers of this species tend to be lavender-rose or deep lavender (similar in colour to *R. cubensis*) while the leaves remain linear and the hypanthia remain smoothish. To the north, in the Atlantic coastal plain, all of the characteristics may vary independently. Therefore, we have inclined toward an even more conservative treatment than that of James, and in a search for some geographical basis for variation in the whole complex have abandoned altogether the var. "exalbida" while reducing the status of two more related entities, *R. interior* Pennell and *R. ventricosa* Fern. & Grisc. to that of varieties of *R. mariana* (see discussion under these varieties).

Plants which might be called *R. mariana* var. *exalbida* do show some constancy of chromosome complement. However if one recognizes this taxon,

then the only feature that distinguishes it from the typical variety of *R. mariana* is the chromosome number (and that does not hold true consistently). In the eastern United States, the typical *R. mariana* has a chromosome number of twenty-two (tetraploid); while, in the western portion of the range, the chromosome number is eleven (diploid). The chromosome number of *R. mariana* var. *exalbida*, if recognized, is eleven.

9. RHEXIA MARIANA L. var. **ventricosa** (Fern. & Grisc.) Kral & Bostick, comb. nov. (Fig. 9, p. 429; map, p. 440.)

R. ventricosa Fern. & Grisc., Rhodora 37: 172, pl. 346, f. 1-4. 1935.

As in *R. mariana* but rhizomes stouter, the stems tending to have subequal faces, the stem angles sharp or quite narrowly winged, the stem surfaces often smoother. Leaves larger. Flowers larger (the petals to 2.5 cm. long) of similar shape but bright lavender-rose (in contrast to contiguous populations of *R. mariana* var. *mariana* which have dull lavender petals), the backs of the petals with at least some appressed hairs (in contrast to contiguous populations of *R. mariana* var. *mariana* which have smooth petals). Hypanthia similar in shape but longer (1-1.2 cm. long), usually hirsute. Seed of similar shape and size, but with close-set papillae in concentric lines. Chromosomes: N equals 22.

Moist to wet sands, peats or sandy peats, of roadbanks, ditches, clearings in cypress-hardwood swamps and flatwoods, coastal plain, New Jersey south into South Carolina.

Type: open clay at border of woods, east of Little Creek, Princess Anne Co., Virginia, *Fernald & Long 4064*. At GH (Isotype at NY examined).

This variety, although it has more characteristics in common with *R. mariana* than with other species may be confused with *R. nashii* or with the variety *interior* of *R. mariana* (which see). However, it may be distinguished from the former by its brighter coloured flowers and hairy hypanthia (*R. nashii* flowers are dull lavender and its hypanthia are smooth) as well as by its subequal stem faces. The only striking character difference this variety was with the var. *interior* appears to be its seed, the surfaces of which have lines of papillae in contrast to the ridged surfaces of seed of the latter.

10. RHEXIA MARIANA L. var. **interior** (Pennell) Kral & Bostick, comb. nov. (Fig. 10, p. 430; map, p. 440.)

R. interior Pennell, Bull. Torrey Club 45: 480. 1918.

As in *R. mariana* but rhizomes stouter, the stems tending to have subequal faces, the stem angles sharp or narrowly winged, the stem surfaces often smoother and with hairs concentrated at or toward the nodes. Leaves larger, usually elliptical or ovate to ovate-lanceolate, the short petioles often maroon. Flowers similar to *R. mariana* in shape but sometimes larger and consistently a bright lavender-rose and the backs of the petals usually with some appressed hairs. Hypanthia as in var. *mariana* but larger (1.0-1.3 cm. long), usually hirsute. Seed ridged, particularly along the crest, the ridges

interrupted or of laterally flattened, dome-like processes. Chromosomes: N equals 22.

Moist to wet sands, sandy clays, or peats of roadbanks, ditches, swamp forest clearings, prairies, glades or flatwoods, southern portion of the Central Lowlands (Indiana, Kentucky, Tennessee) south into west-central Mississippi, thence west to the prairie border in north Texas, Oklahoma, but centering in the Interior Highlands.

Type: high prairies, Alba, Jasper Co., Missouri, *Bush 6070*. At MO. Isotype at NY examined.

The great similarity of this variety to the variety *ventricosa* is inescapable. Yet a considerable distance separates the two, at least as their ranges are now understood, and would lead one to assume either an independent origin of similar morphology (by hybridization) or a relict "pair" which at one time was contiguous. James (l.c.) has speculated that both *R. interior* and *R. ventricosa* could have originated through hybridization between *R. mariana* and *R. virginica*, yet the appearance of such hybrids (which are fairly frequent in Georgia and north Florida) is quite different. Our experience with *R. mariana* var. *interior* is that its flowering time overlaps that of *R. mariana* more closely than it does that of *R. virginica* and that intermediates between these two entities are not uncommon.

There appears to be some morphological range within the variety *interior*. Populations of northern Louisiana have larger stature, larger flowers and hypanthia than those of the Ozarks from which the type material was described. (Compare Louisiana numbers *15716*, *15744*, *15948*, *19400*, *20325*, *23275*, *23239*, *24521* with Arkansas numbers *24600*, *24603*, *24574* and Oklahoma *24607*). Yet, in that portion of northern Louisiana in which this variety is found, *R. virginica* is quite rare, certainly having none of the weedy character common to all varieties of *R. mariana* and little opportunity appears to arise for much exchange of pollen between the two.

11. RHEXIA CUBENSIS Griseb, Cat. Pl. Cub. 104. 1866. (Fig. 11, p. 431; map, p. 437.)

R. mariana L. var. *portoricensis* Cogn. Jahrb. Bot. Gart. Berlin 4: 276. 1886.

R. floridana Nash, Bull. Torrey Club 22: 150. 1895.

Profusely rhizomatous (also tuberiferous) strict or bushy perennials. Shoots 3-6 cm. long, glandular hirsute, subterete, subligneous, with thin, reddish-brown bark toward the base, upwardly greenish. Leaves predominantly linear, linear-elliptic, oblong, or narrowly spatulate, (only the midrib prominent), 2-4 cm. long, pale to deep green or with maroon tints, both surfaces with a scattering of long, glandular trichomes, the apex obtuse to short-acuminate, the margin regularly low-toothed, the teeth ascending and each terminating in a glandular hair. Leaves grading gradually upward to longest toward midstem, thence becoming gradually shorter into the inflorescence, where they abruptly shorten into narrowly elliptic or short-linear bracts. Inflorescence a few-to-several-flowered, paniculate cyme, the

hypanthia tending to develop in secund fashion on the inner side of the inflorescence branches. Petals broadly cuneate or obovate, 1.5-2.0 cm. long, spreading horizontally, bright lavender-rose or sometimes paler, almost white toward the short-clawed base, smooth or with a very few glandular hairs on the backs, the midvein exserted as a hair. Anthers at anthesis linear-lanceolate, curvate, 7-10 mm. long, on filaments of about the same length. Mature hypanthium 10-14 mm. long on pedicel 2-3 mm. long; hypanthial base ovoid or subglobose, usually tapering into a gradually expanding neck at least as long as the hypanthial body; sepal lobes narrowly triangular or oblong, usually reflexed at fruiting time, acute. Hypanthial hairs scattered, glandular, sometimes sparse or wearing away by maturity. Capsule smooth, subglobose. Seed cochleate, ca. 0.7 mm. long, concentrically and rather evenly ridged, particularly along the crest. Chromosomes: N equals 11, 22, 33.

Peats and sandy peats of pine flatwoods, ditches, margins of bogs, and hillside seepage areas, not infrequently a weed of roadsides, eastern North Carolina south to the tip of Florida, west in the Coastal Plain to southwestern Mississippi; in the West Indies, such as Cuba, Dominican Republic, Puerto Rico.

Type: damp ground near lagunas Asiento Viejo in San Julian, Cuba, *Wright*. Isotype at GH.

R. cubensis could only be confused with narrow-leaved examples of *Rhexia mariana* var. *mariana*, particularly populations of the latter which have lavender-rose petals. This situation is most encountered in peninsular Florida, where *R. mariana*, chameleon-like, takes on some "cubensis" character. However, *R. mariana* never produces tubers, its flowers in that region are consistently smaller, and its hypanthia much smaller and smoother. Seed characteristics do not always suffice to distinguish these two entities.

R. cubensis grows closer to the present coast than do most other Rhexias (with the possible exception of *R. mariana*, *R. salicifolia*, *R. virginica*), and is probably the commonest species of the slash pine flatwoods of peninsular Florida. While breeding studies at this point do not show that F-1 hybrids between *R. cubensis* and *R. mariana* or *R. nashii* produce viable seed it is still possible that such a phenomenon may, on occasion, occur.

12. RHEXIA NASHII Small, Fl. SE. U.S. 824. 1335. 1903. (Fig. 12, p. 432; map, p. 437.)

R. mariana L. var. *purpurea* Michx., Fl. Bor.-Am. 1: 221. 1803.

Hirsute perennials, forming extensive clones from shallowly set, elongate, stoloniferous, sometimes tuberiferous, rhizomes. Shoots (2-) 3-10 (-15) dm. tall, the lower portion brownish or reddish-brown, subligneous and often with exfoliating bark, becoming hirsute, greenish or yellowish-green or reddish-green by mid-stem. Leaves commonly of an ovate, lance-ovate, elliptic or lanceolate shape, 3-7 cm. long, yellow-green, both surfaces hirsute, the apex acute, the margins finely to rather coarsely serrate, the teeth drawn out into hairlike tips and often with hairs on their margins; leaf bases acute,

often short-petiolate. Leaves gradually shortening into the inflorescence; bracts of similar shape and vesture to foliage leaves but much smaller. Inflorescence an open or contracted, symmetric cyme, the fruiting hypanthia sometimes secund on the inside of the cyme branches. Petals asymmetrically and broadly obovate or even suborbicular, 2.0-2.5 (-2.7) cm. long, usually dull lavender, the mid-vein exserted as a short hair, the backs appressed hairy. Anthers 8-11 mm. long, linear-lanceolate, on filaments of corresponding length. Mature hypanthium glabrous or glabrate, 10-15 (-20) mm. long on pedicels 2-4 mm. long; hypanthial body ovoid to subglobose, abruptly or gradually passing into the cylindrical or narrowly funnelform neck which is at least equal in length; sepal lobes narrowly triangular, acute or acuminate, 2-4 mm. long. Capsule pyriform, usually completely glabrous. Seeds about 0.7 mm. long, cochleate, the surfaces concentrically lined with contiguous, dome-shaped, sometimes laterally flattened, processes, these most noticeable on the crest of the seed. Chromosomes: N equals 22, 33.

Acid, sandy or peaty swamps and bogs, roadside ditches, and flatwoods, invariably on wetter substrates than *R. mariana*, Coastal Plain, eastern Virginia south to southern Florida and west to the Florida parishes of Louisiana.

Type: swamps, in the vicinity of Eustis, Lake Co., Florida, *Nash 863*. At NY.

R. nashii, which so often resembles a large version of *R. mariana* var. *mariana*, invariably may be distinguished from that variety by its smoother hypanthia, much larger petals, and especially by its petal hairs. This latter characteristic is particularly useful on herbarium specimens, in that the hairs of *R. nashii* petals are best developed on that portion of the petal backs exposed on the bud.

A greater problem is in distinguishing *R. nashii* from *R. mariana* var. *ventricosa*, which itself has hairy petals and large hypanthia, together with some similarities in habitat, habit and leaf. However the latter may be distinguished by its more rose-tinted petals, the hair of its hypanthia, and its subequal stem faces. So far as we know the ranges of *R. nashii* and *R. mariana* var. *interior* do not overlap or a similar problem of identification would exist for these collections.

R. nashii and *R. mariana* frequently hybridise. Such have been reported by James, and we have made similar observations (*Kral 15678-15679, 19111-19112*). Occasional intermediate morphologies between it and *R. cubensis* are to be found in peninsular Florida. In southern Alabama, Mississippi and in northern Florida it frequently hybridises with *R. virginica*, a fact confirmed by breeding studies.

13. RHEXIA ALIFANUS Walt., Fl. Carol. 130. 1788. (Fig. 13, p. 433; map, p. 437.)

R. glabella Michx., Fl. Bor.-Am. 1: 222. 1803.

R. glabella Michx. var. *alifanus* (Walt.) Pursh, Fl. Am. Sept. 1: 258. 1814.

Tall, 6.5-11.5 (-20) cm., sparingly-branched, perennials from a stout, pithy, deepset caudex. Shoots glabrous, usually unbranched below the inflores-

cence, the lowest portion terete, reddish-brown, occasionally with a thin, exfoliating bark; upper portion greenish, each internode somewhat flattened in a plane parallel to that of the subtending leaf pair, and longitudinally striate, the narrower, paler green bands aligned with leaf midribs. Leaves predominantly lance-ovate to elliptic or lanceolate, at mid-stem 3.5-7.5 cm. long, 7-10 (10.5) mm. broad, smooth, bluish or yellowish-green, evidently triple-nerved, subsessile, the apex acute or short-acuminate, the margin entire or remotely low-toothed apically the base cuneate. Leaves gradually becoming longer toward mid-stem, then gradually reduced into the inflorescence, there abruptly giving way to small (2-3 mm.) ovate, glandular-hairy, caducous, bracts. Inflorescence a regular, oblong or spreading, paniculate cyme. Petals broadly oblong to suborbicular, 2.0-2.5 cm. long, lavender-rose, the principal veins asymmetrical, palmate, purple, the midvein exserted as a short, fine mucro, the inner surface smooth, the outer surface with some hairs on the small-area side of the midvein beneath. Anthers at anthesis yellow, linear-lanceolate, curvate, 7-8 mm. long, short-appendaged, on filaments 6-8 mm. long. Mature hypanthia usually glandular-hairy, 7.5-10.0 mm. long, on stout, terete, pedicels 3-4 mm. long and markedly broader than the subtending inflorescence branches; hypanthial base subglobose to broadly ovoid, longer than the abruptly constricted neck; hypanthial neck flaring abruptly into a flange-like orifice nearly as broad as the hypanthial base. Sepal lobes oblong or narrowly triangular, acute or blunt, usually smooth. Capsule pyriform, smooth or with a few scattered hairs apically. Seeds oblong to wedge-shaped, 1-2 mm. long, smoothish. Chromosomes: N equals 11.

Sandy peat of pine flatwoods, bogs, sevannas, Coastal Plain, eastern North Carolina south into northern peninsular Florida, thence west into eastern Texas.

Type: cutover, low, wet pineland 8 mi. w. Pineville, Berkeley Co., S.C. *James 675*. (This a neotype deposited at GH).

This *Rhexia*, with its smooth, wand-like stems, smoothish cleancut leaves, large showy flowers and conspicuously glandular-hairy hypanthia is one of the most clearly marked species in the genus and may actually have closer affinities with some tropical-American genus. Its seed, sometimes fully twice the size of that of other *Rhexia*, differs also in its unique, usually somewhat triangular, shape.

The distribution of *R. alifanus* in Florida is rather interesting, closely paralleling that of the yellow flowered *R. lutea*, in that its southern limits there are in the northern part of the peninsula (Volusia Co.). It is most abundant in and about the *Stokesia-Sarracenia* bogs of northwest Florida, southern Alabama, and southern Mississippi.

RHEXIA HYBRIDS

As James has observed, it would appear that no natural hybridization involving *R. nuttallii*, *R. petiolata*, *R. lutea*, *R. parviflora* or *R. alifanus* occurs. However, artificial hybrids between *R. nuttallii* and *R. petiolata* have

been gotten which have produced full seed. James got viable seeds from crosses he made between *R. virginica* and *R. nashii*, and *R. mariana* and *R. nashii*; he also has observed hybrids between *R. aristosa* and *R. virginica*, *R. virginica* and *R. mariana*. All these have been observed in the field or in the greenhouse during this particular study. Some comment about this follows.

Naturally occuring hybrids. Hybrid swarms involving *R. mariana* var. *mariana* and *R. nashii* are not uncommon; samples from such swarms (i.e. *Kral 15678-15679, Kral 19111-19112*) show a gradual transition from tall plants with large, smooth hypanthia and broadly lanceolate or elliptic leaves to lower plants with much smaller hypanthia and lineal leaves; flowers in these samples range gradually from large, lavender petals to much smaller and paler corollas; seed characters are likewise variable. Hybrid swarms involving *R. mariana* var. *mariana* and *R. virginica* are also fairly frequent (i.e. *Kral 15555, 15685, 19307, 19325, 28634, 28637, 28638, 28640*); the F-1 is a plant of intermediate height and stockiness, with angled but not winged stems, with narrowly lanceolate to almost lineal leaves, hypanthia of about the size and shape of *R. mariana* but with very few full seed in the capsules, and only a scattering of ripe fruit, most having shrivelled and fallen from the plants. However, some backcrosses do appear or at least there are morphologies in such populations that would be difficult to explain otherwise. In these latter cases a greater proportion of capsules remain on the plant and a larger number of full seed is found, as would be expected. One case of hybridization between *R. mariana* var. *mariana* and the new species, *R. salicifolia* is here reported; however this must be of rare occurrence, for none have been reported from any other of the several localities where both are found. In northwest Florida, southern Alabama, and in southern Mississippi samples have been collected from several naturally occurring hybrids of *R. nashii* and *R. virginica*. These are recognized by their rhizomatous habit (a *nashii* character), greater amount of maroon pigmentation of stem and foliage (a *virginica* character), four angled, but not winged, stems, their sparsely hairy hypanthia which are longer than *R. virginica* but shorter than *R. nashii*, their bright lavender-rose petals which are larger than those of *R. virginica* but smaller than those of *R. nashii*, and their intermediate seed character. Examples at VDB are *Demaree 32982, Kral 17449, Kral 15649, Kral 22052, Kral 22046, Kral 25859, Kral 25847, Kral 29676*. While experimental hybrids between *R. mariana* and *R. cubensis* do not themselves form viable seed, it is to be suspected that this must sometimes happen in nature. There is hardly any other explanation for the fact that in peninsular Florida populations of *R. mariana* take on many "cubensis" characteristics such as (a.) more glandular pubescence (b.) more maroon pigmentation (c.) "cubensis" type leaves and leaf arrangement (d.) the deep and bright lavender-rose petal colour. Whole populations of *R. mariana* var. *mariana* may have the characteristics mentioned and yet examples of actual F-l's between these and *R. cubensis* which cohabits the areas are not

found. Perhaps the paradox could be explained in terms of very occasional seed being formed by very infrequent F-1's, this germinating and establishing populations vegetatively and subsequently backcrossing to form what comprise the common *R. mariana* of southern Florida.

Experimental hybridization. Living transplants were maintained at the North Carolina Botanical Garden at Chapel Hill, North Carolina. Fine-mesh nylon stockings were used as bags to prevent normal insect pollination. Stamens from the pollen parent were removed and the pollen was teased out of the anther with a needle. The pollen was transfered to receptive stigmas of newly opened, emasculated flowers of bagged plants. At least three duplicates were made of each cross and reciprocal crosses were made in each case. Seed formed, if any, was collected as the capsules matured and sowed onto a 1:1 mixture of sand and peat in plastic pots. The pots were placed in trays, watered from beneath, and placed in a cold room for a month. The trays were then removed to a greenhouse and watered from beneath once a week.

Apparently, the chief isolating mechanism(s) operating within most of the taxa of the genus is an incompatibility factor or factors. Stebbins (1966) has classified isolating mechanisms into two large categories: prezygotic, in which fertilization and zygote formation are prevented in various ways and postzygotic, in which fertilization takes place and hybrid zygotes are formed, but these are inviable or give rise to weak or sterile hybrids.

In artificial crosses within *Rhexia*, three types of results were obtained (Fig. 14):

1. Seeds were not formed.
2. Seeds were formed and would not germinate.
3. Seeds were formed and would germinate.

In those crosses in which no seeds were formed within the receptive flower, it is presumed that the isolating mechanism involved is prezygotic, since the gametes probably never fused. The actual mechanism here could be a stigma- or style-pollen incompatibility. It must also be recognized that there is a possibility that the isolating mechanism involved in these crosses occurs at a very early postzygotic stage. This might account for the failure of seed formation.

In those crosses in which seeds were formed but would not germinate, the isolating mechanism must be postzygotic, since these seeds, when dissected, were found to contain embryos but no endosperm.

In those crosses in which seeds were formed and would germinate, the seeds were found to contain both embryos and endosperm. However, the progeny of these crosses have all died since the crosses were made. This could be the result of poor cultural conditions or of another postzygotic mechanism.

The only species which formed viable seeds when self-pollinated (pollen and stigma of same flower and pollen and stigma of different flower but same plant) were *Rhexia petiolata* and *R. lutea*. Whether or not self-pollina-

tion (and self-fertilization) occurs regularly in nature remains in doubt. From breeding studies, it has been learned that plants of these two species will also form viable seeds when outbred. All of the other taxa are obligate outbreeders.

When an artificial cross "took," the plants involved were invariably of the same ploidy level. When no viable seeds were formed, the isolating mechanism was postzygotic (inviable seeds formed) if the ploidy levels were the same, or was presumably prezygotic (no seeds formed) if the ploidy levels were different. Crosses at the hexaploid level never resulted in the formation of viable seeds.

PAPER CHROMATOGRAPHY

Extracts of leaves from the third node below the base of the inflorescence of herbarium specimens and of petals of the same specimens were made with 0.5% hydrochloric acid in methanol. Two-dimensional descending paper chromatograms of all taxa were prepared with the first-dimension solvent of 3 tertiary butanol: 1 glacial acetic acid: 1 water. The second-dimension solvent was 15% acetic acid. The chromatograms were dried and viewed against ultraviolet light in ammonia vapor. An effort was made to sample each taxon from representative localities throughout its range. Compounds appearing as chromatogram spots were not identified but the colors and spot patterns were used as taxonomic devices.

Very little intraspecific variation in chromatographic patterns was observed: hence it was possible to characterize each taxon or ploidy level with a "type chromatogram" (Fig. 15-50). Chromatograms of leaves and petals gave approximately equivalent results, although petal chromatograms were more useful in separating one taxon from another. Spots of the two types of chromatograms were not the same but, in most cases, the chromatographic affinities of the groups were expressed in the same manner. Table II presents the results of a survey of the number of distinctive spots for each taxon.

One of the most interesting chromatographic patterns obtained was that of *Rhexia alifanus*. In both leaf and petal chromatograms, this species had very few spots in common with the other taxa of the genus.

The petal chromatograms of the yellow-petaled *R. lutea* show little affinity to those of other species. The leaf chromatograms have no distinctive spots but are unique in that only two spots are present.

Although Series A (Small's Ellipticae) shows little chromatographic affinity to Series B (Small's Lineares), its members show even less affinity to one another. *Rhexia nuttallii* leaf chromatograms have about 40% of their spots in common with members of Series B and about 27% of *R. nuttallii* spots are shared with the other two species of Series A.

Chromatography has shed some light on the question, originally raised by James (1956), of the possible intermediacy of *Rhexia parviflora* to Series A and Series B. *Rhexia parviflora* shares 62% of its petal chromatogram spots with *R. petiolata* of Series A and this is considerably higher than the percent

TABLE II

DISTINCTIVE CHROMATOGRAPHIC SPOTS IN *RHEXIA*

Taxon	*Leaf Chromatograms*		*Petal Chromatograms*	
	No. of Spots	*Number Distinctive*	*No. of Spots*	*Number Distinctive*
R. petiolata	14	3	6	0
R. nuttallii	7	1	8	1
R. lutea	2	0	5	5
R. salicifolia	9	0	3	0
R. parviflora	5	0	7	0
R. aristosa	7	0	4	0
R. virginica, n=11	6	0	6	0
R. virginica, n=22	8	1	9	1
R. mariana var. *interior*	7	0	11	0
R. mariana var. *ventricosa*	7	0	12	0
R. mariana, n=11	6	0	11	0
R. mariana, n=22	8	0	9	0
R. cubensis, n=11	6	0	5	0
R. cubensis, n=22	7	0	6	0
R. cubensis, n=33	7	0	7	0
R. nashii, n=22	8	0	7	0
R. nashii, n=33	9	0	8	0
R. alifanus	21	13	9	3

shared with at least half of the other members of Series B—its morphologically closest relatives.

Rhexia interior and *R. ventricosa* have been said to be of possible hybrid origin by James, who indicated that *R. mariana* and *R. virginica* could be possible parental species. Chromatographic studies seem to support the hypothesis that *Rhexia interior* and *R. ventricosa* may be rather closely related to *R. mariana*. The tetraploid forms of *R. mariana* and *R. virginica* (n = 22) have exactly the same number of spots in common with *R. interior* and *R. ventricosa*, both of which are also tetraploid taxa. *Rhexia interior* and *R. ventricosa* show more chromatographic affinity to each other when leaf chromatograms are compared (100% of spots in common) than when petal chromatograms are compared (64% of spots in common); but are definitely closely related, both chromatographically and morphologically. Indeed, other than by the use of James' seed characteristics, the only way that many students are able to separate the two taxa is by their distributions. All of the above data lend weight to our opinion that *R. interior* and *R. ventricosa* should receive no more than varietal status within *Rhexia mariana*.

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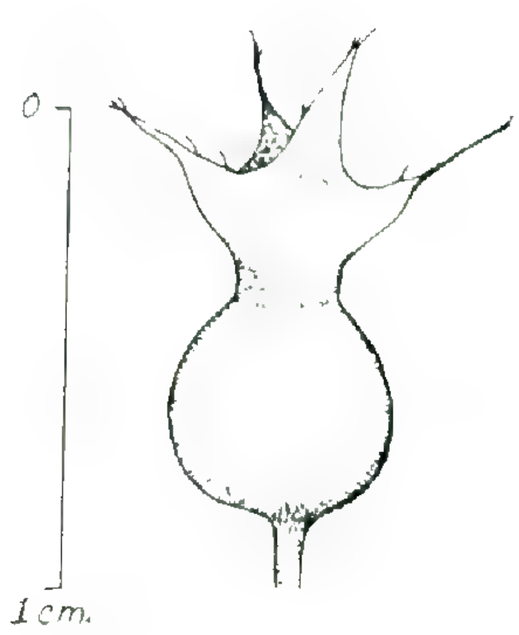
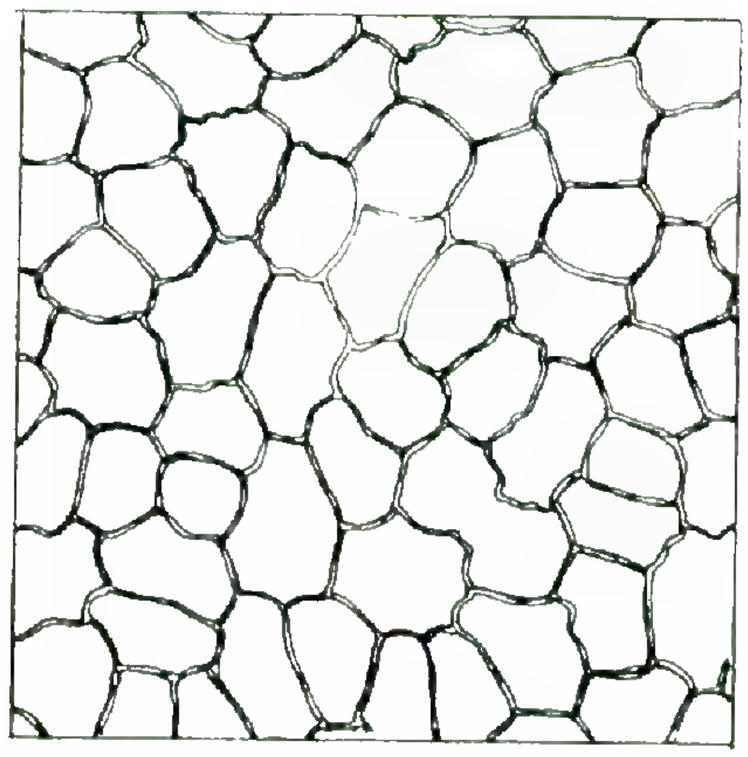
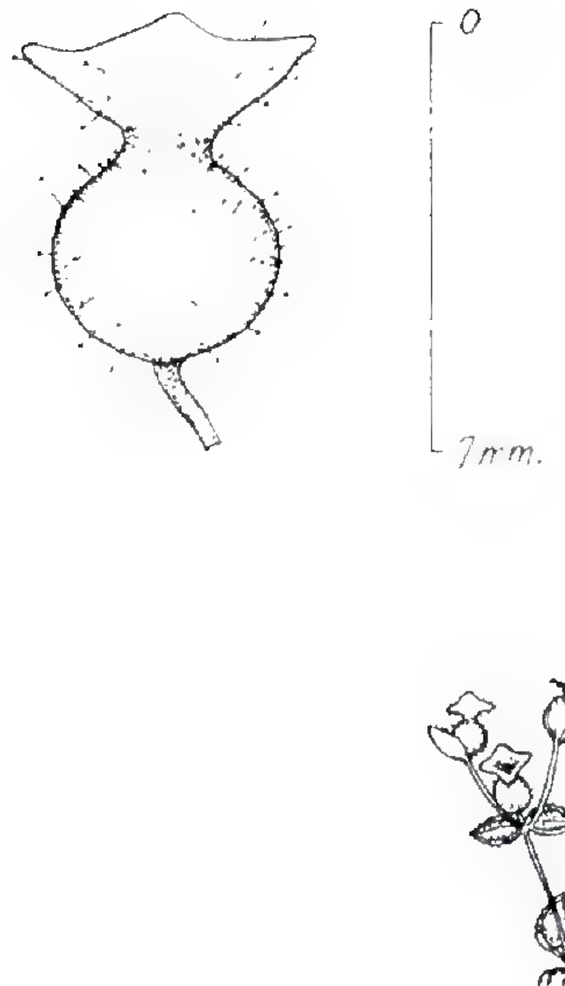
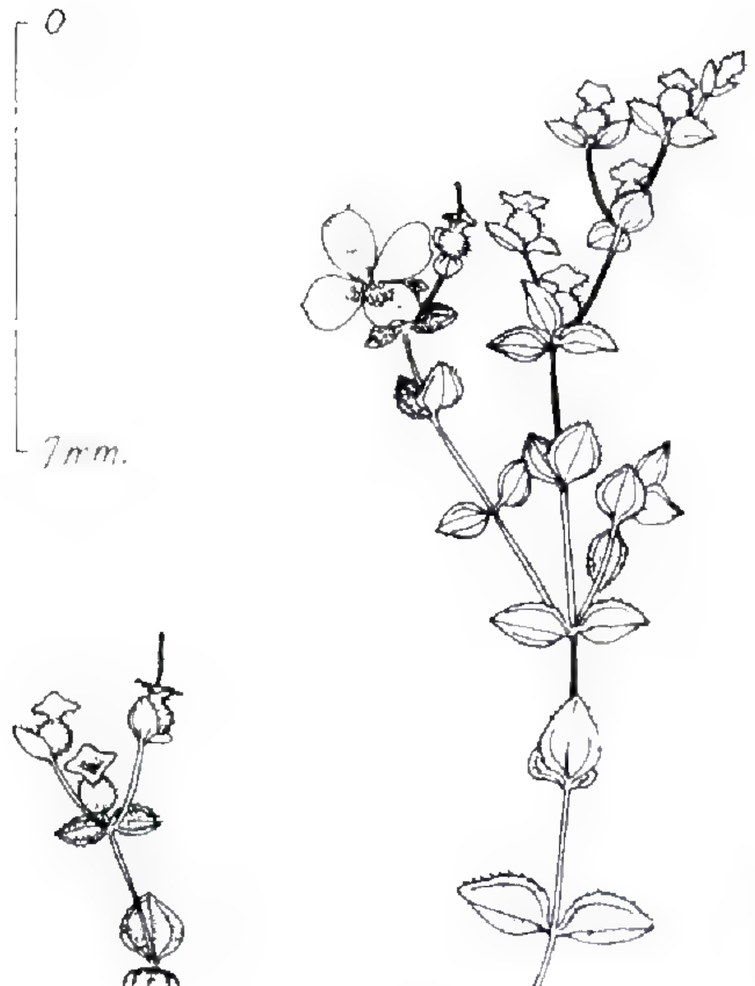
ILLUSTRATIONS OF RHEXIA SPECIES (Figs. 1—13). Showing mature hypanthium, habit sketch, seed (scale as indicated for each), sector of upper epidermis of leaf (enlarged).

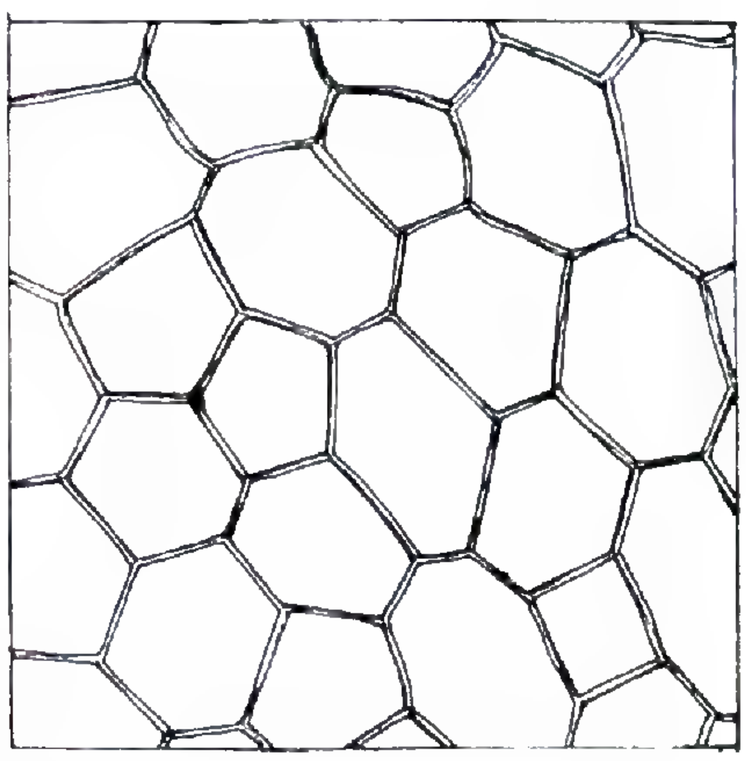




1. RHEXIA PETIOLATA (p. 400).

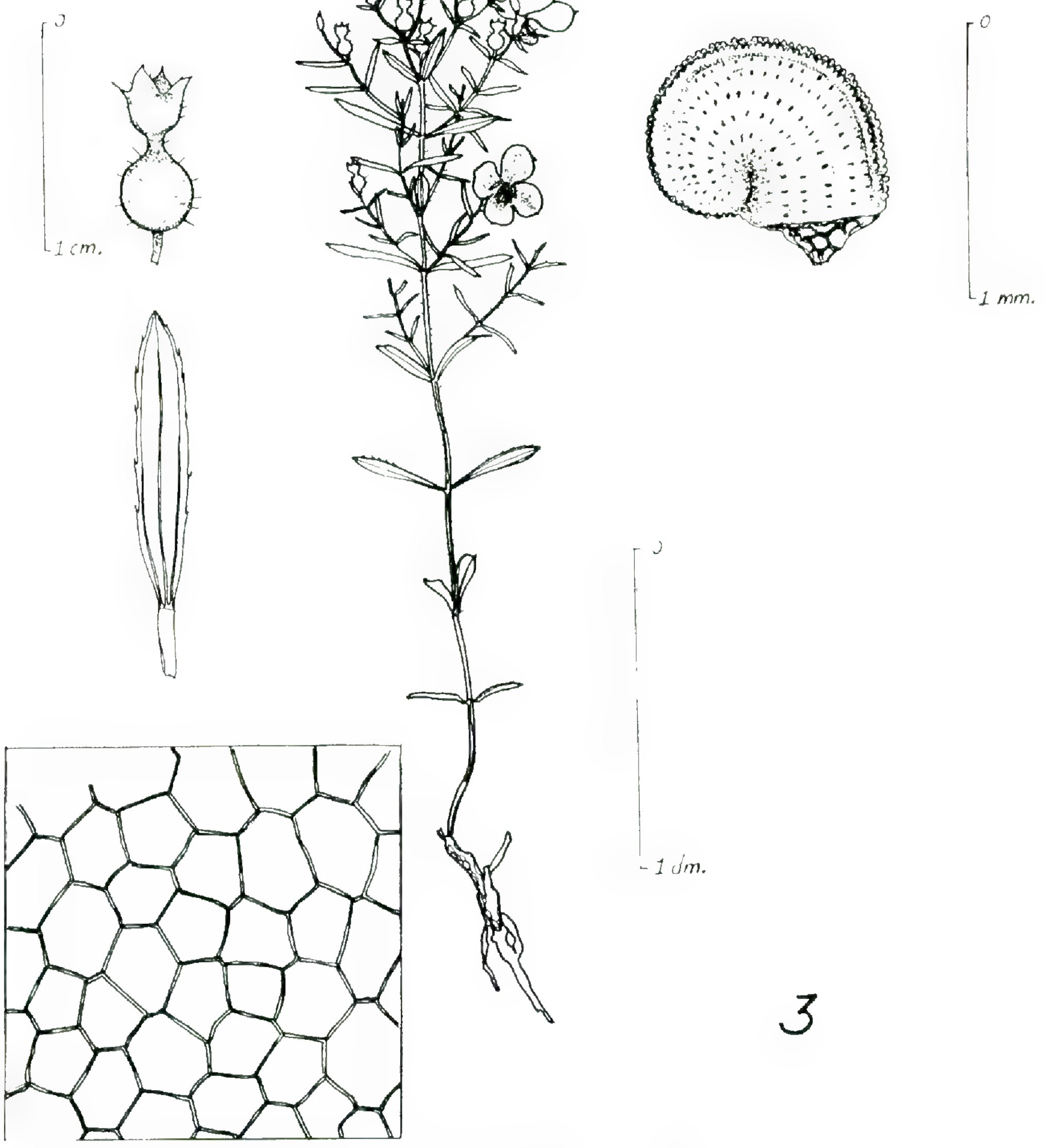




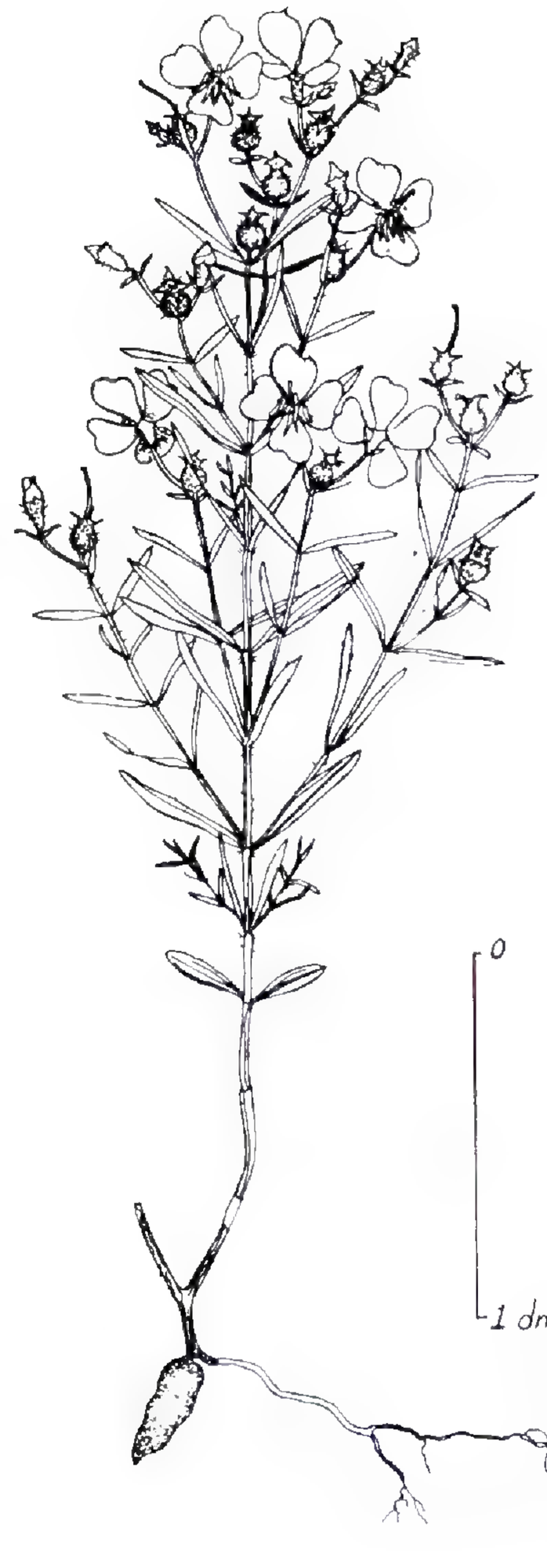


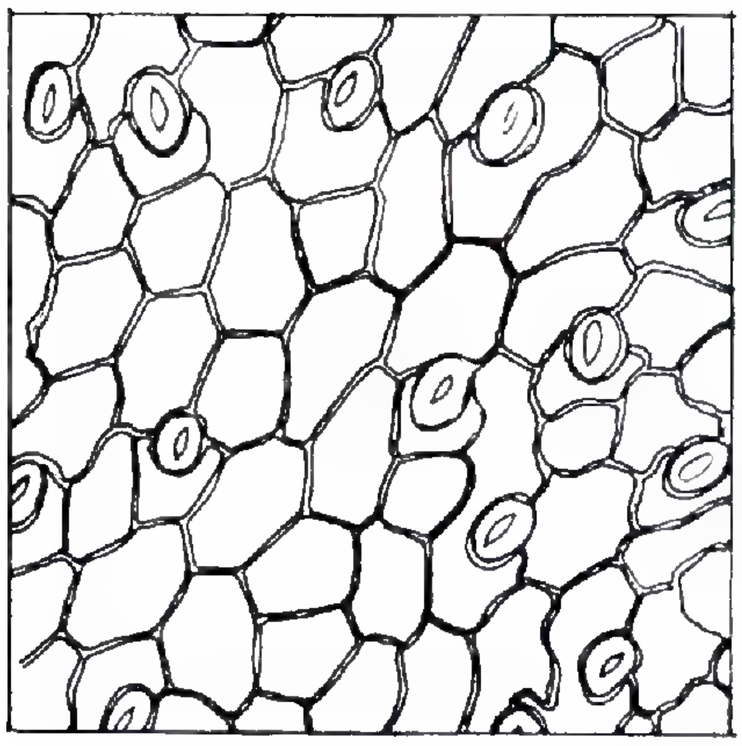
2

2. RHEXIA NUTTALLII (p. 401).



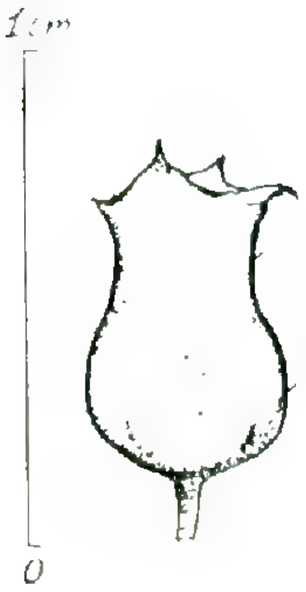
3. RHEXIA LUTEA (p. 401).

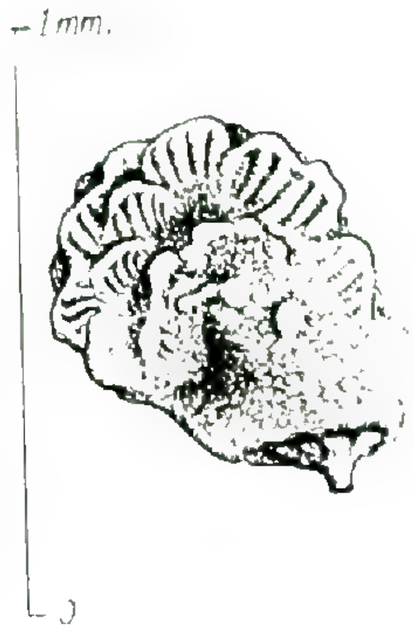




4

4. RHEXIA SALICIFOLIA (p. 402).





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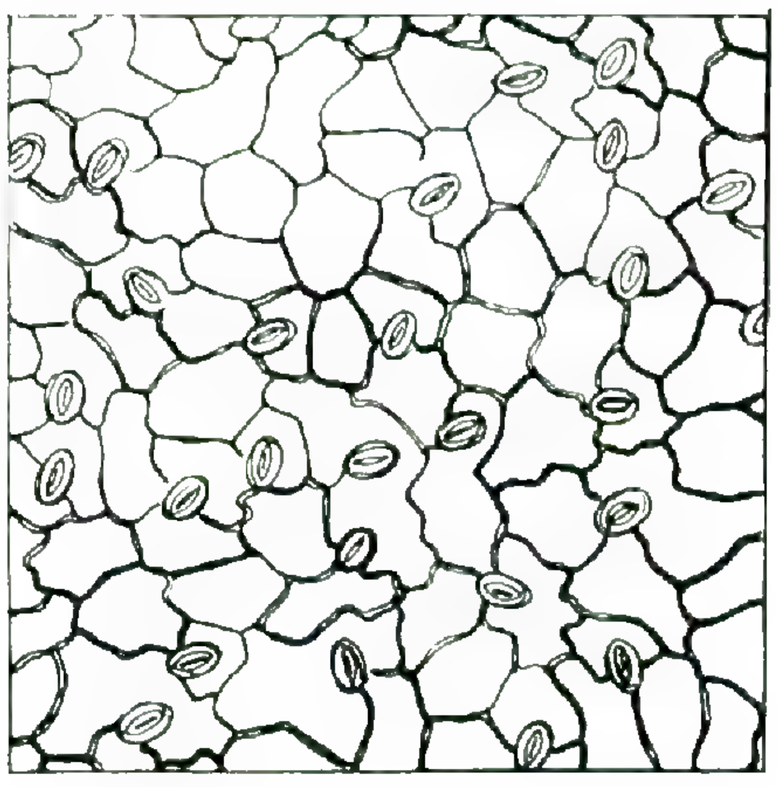
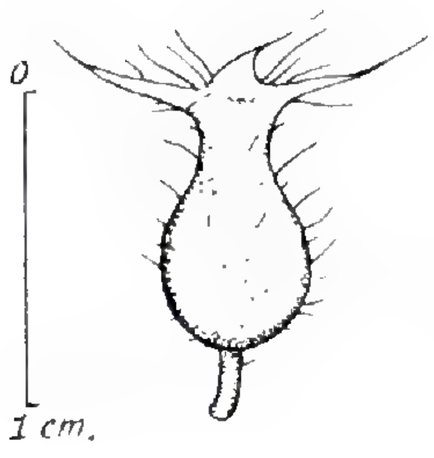
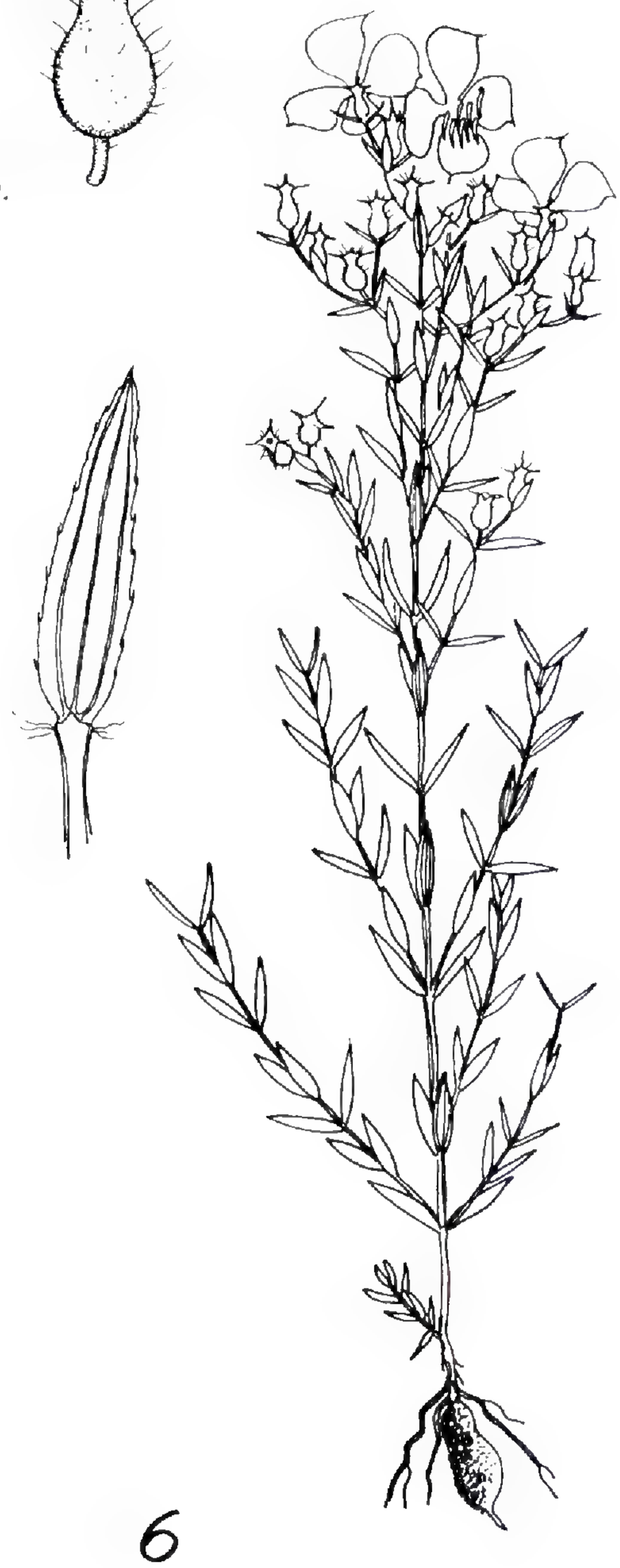
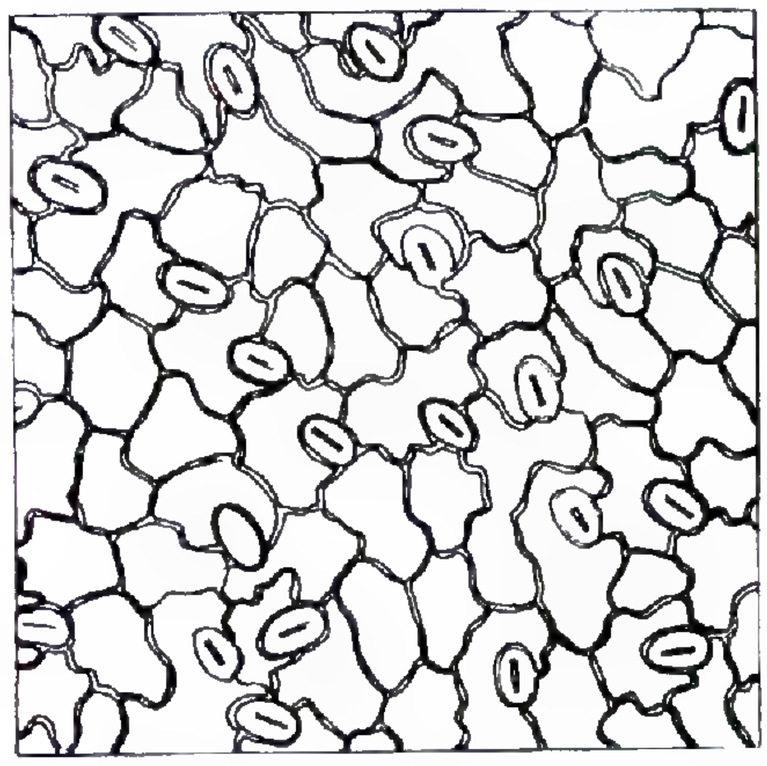


5. RHEXIA PARVIFLORA (p. 405).

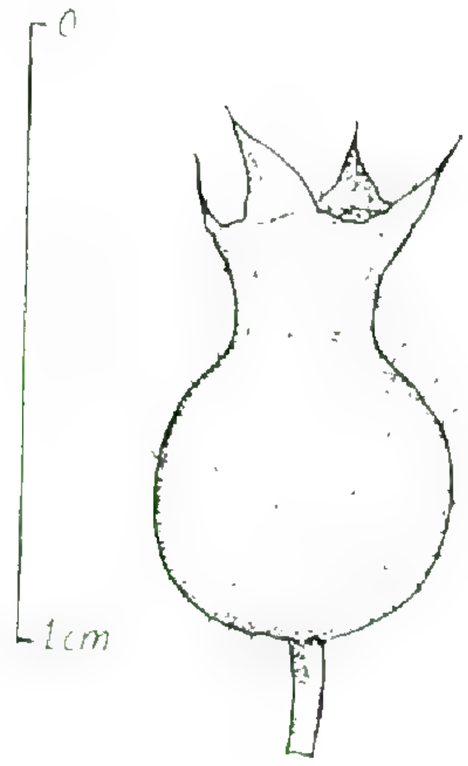


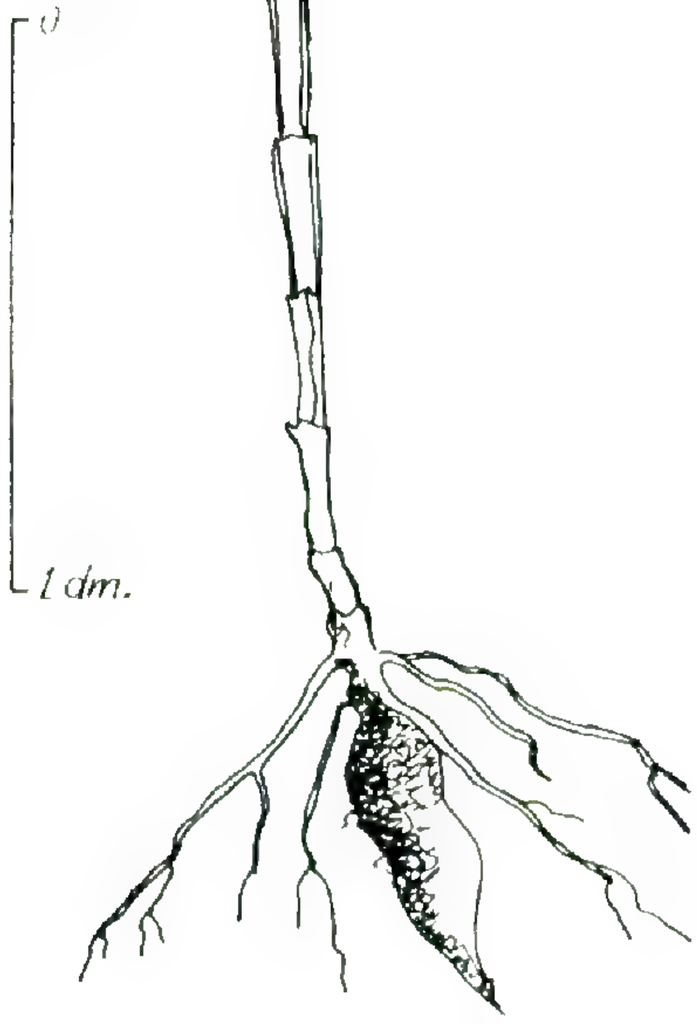


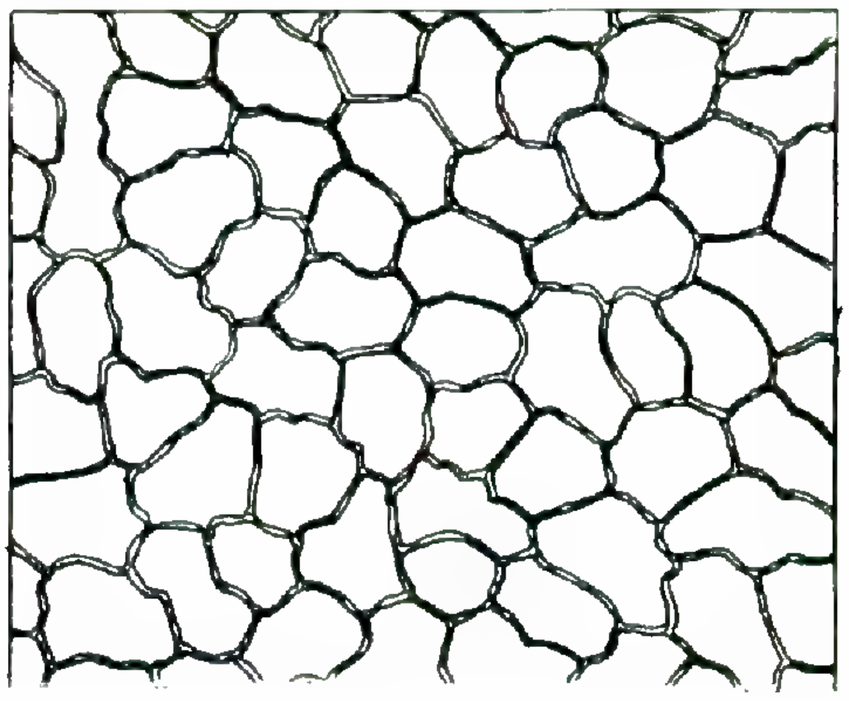


6

6. RHEXIA ARISTOSA (p. 406).







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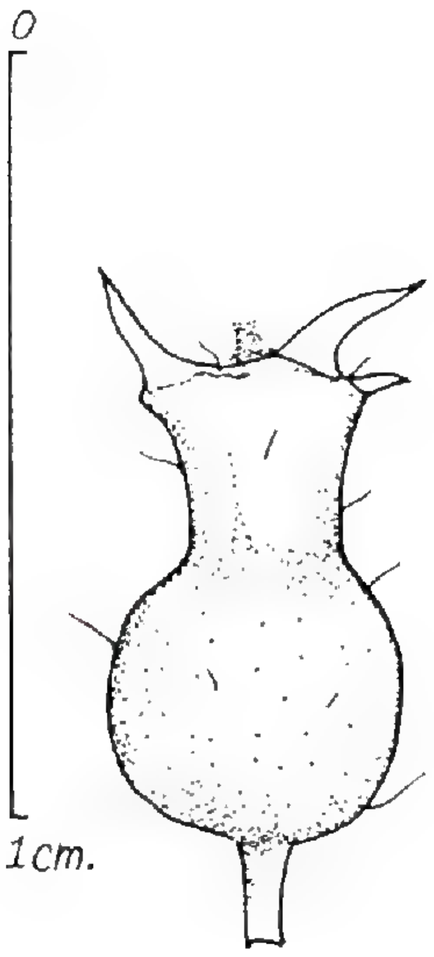
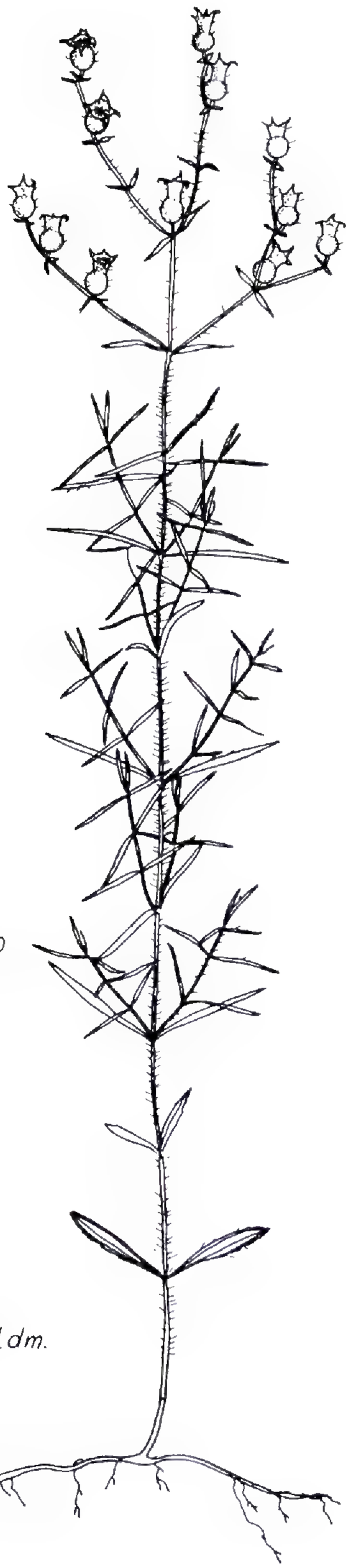
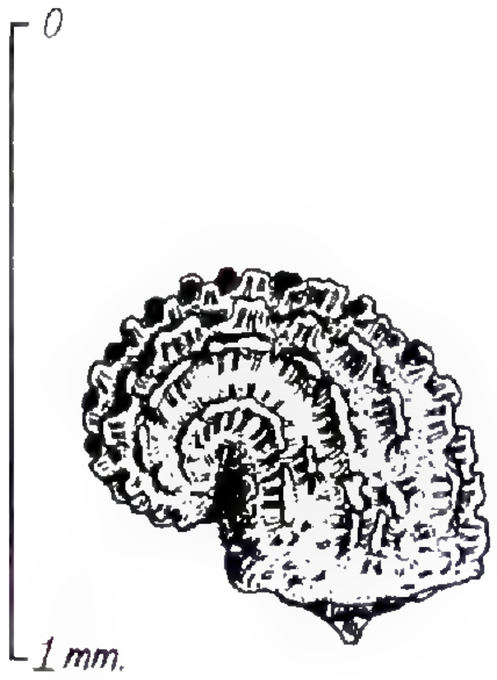
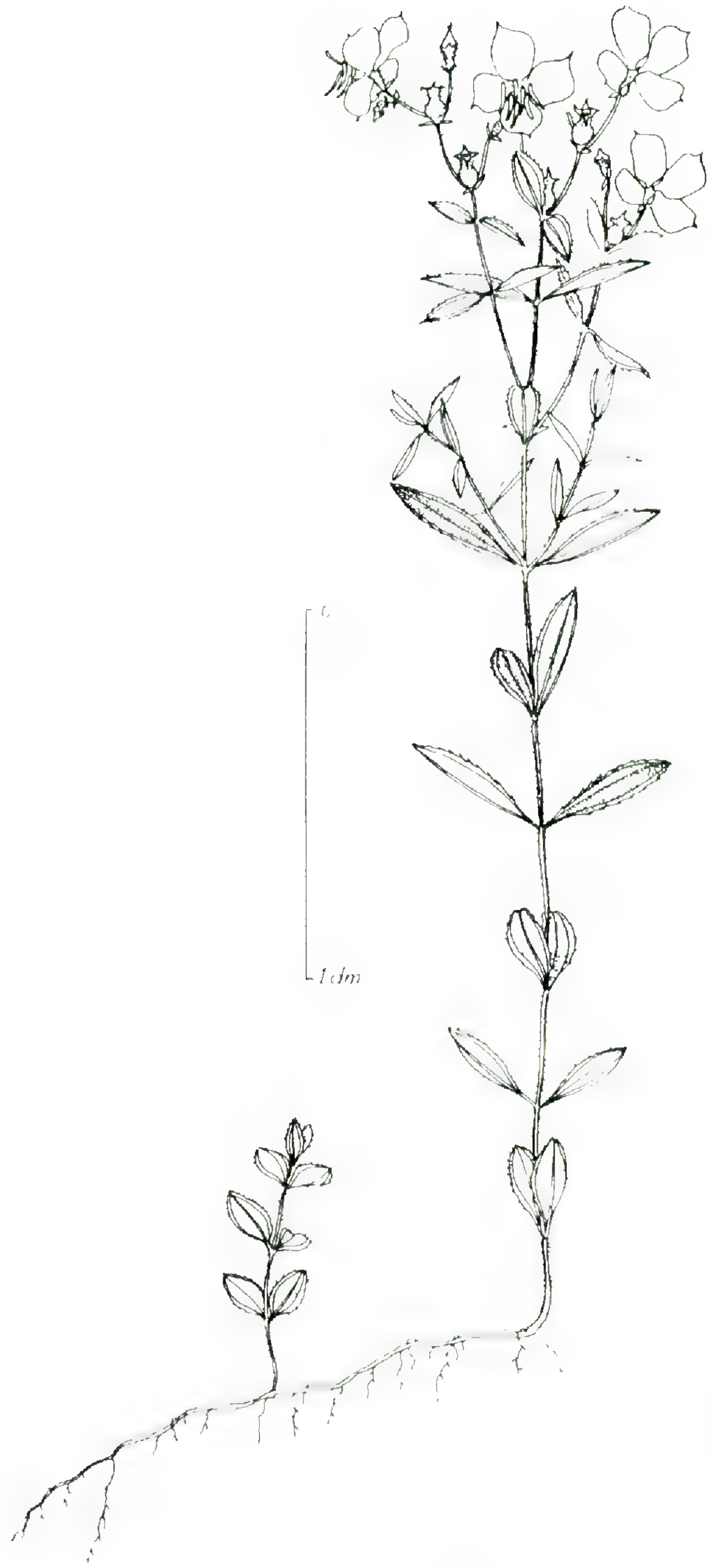
7. RHEXIA VIRGINICA (p. 407).



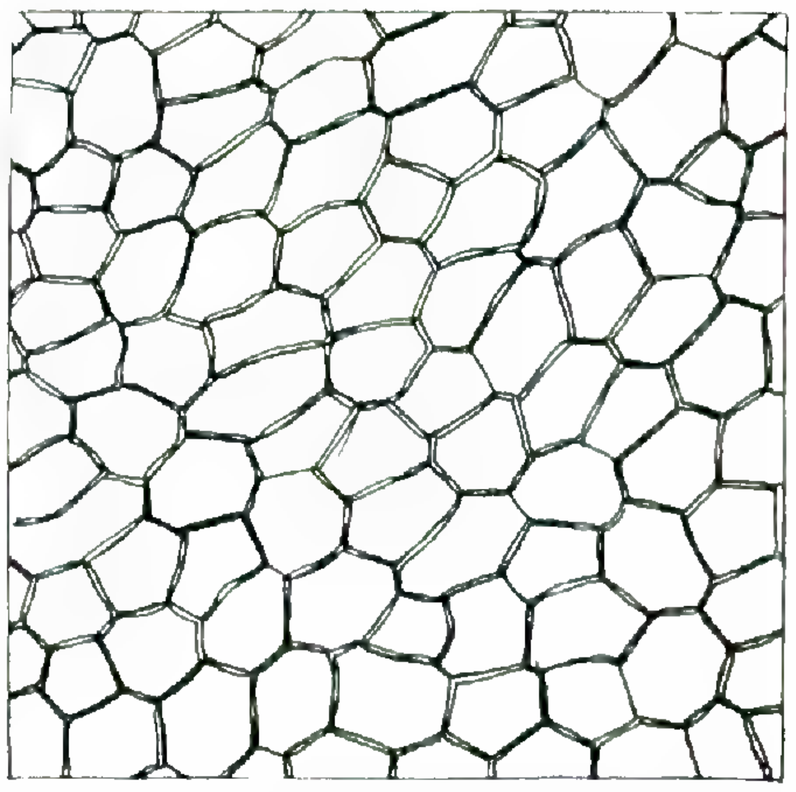




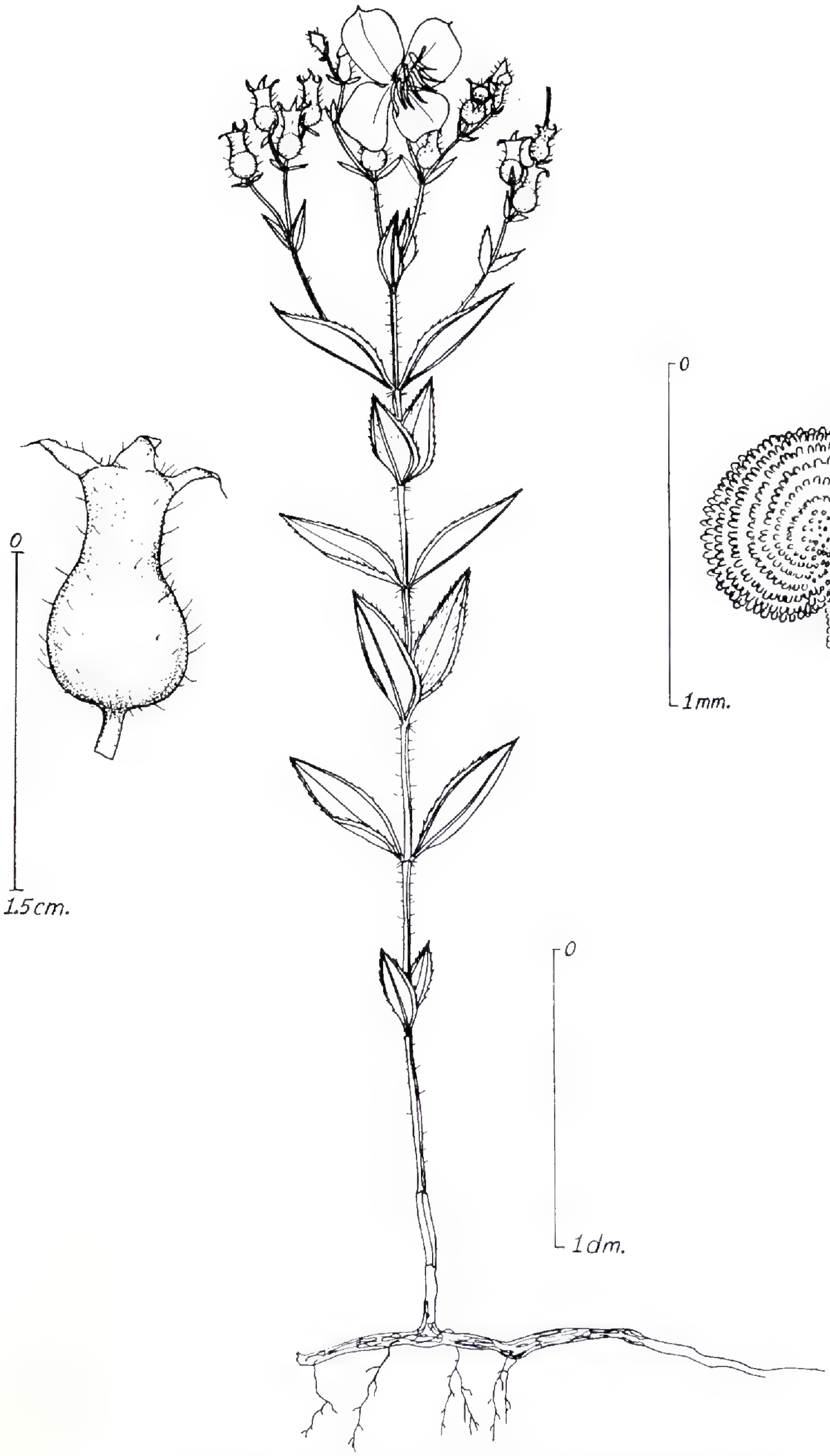
8a. RHEXIA MARIANA VAR. MARIANA, sun (narrow-leaved) plant from same clone as 8b. (p. 408).



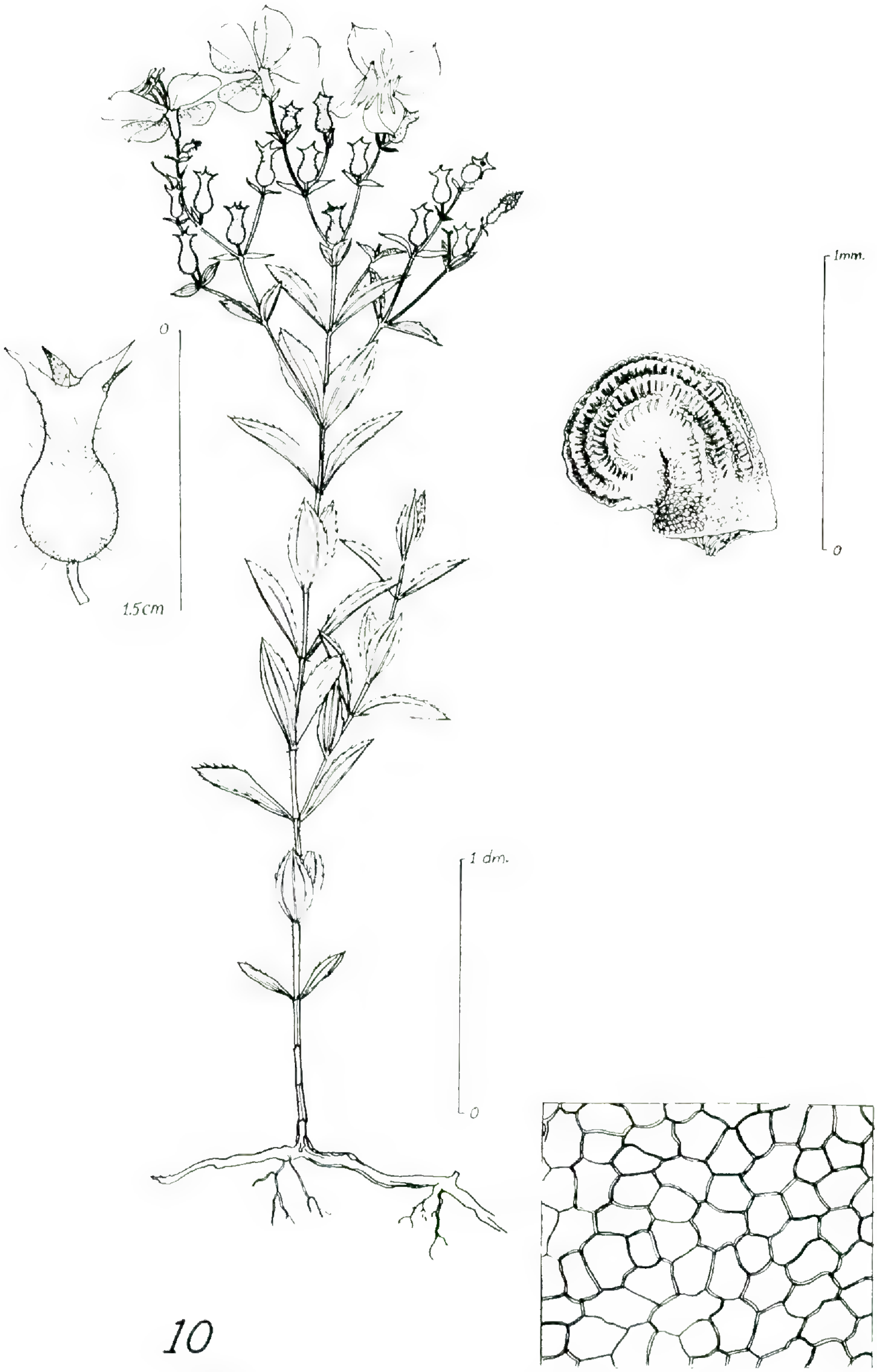
8b



8b. RHEXIA MARIANA VAR. MARIANA, shade (broad-leaved) plant from same clone as 8a. (p. 408).

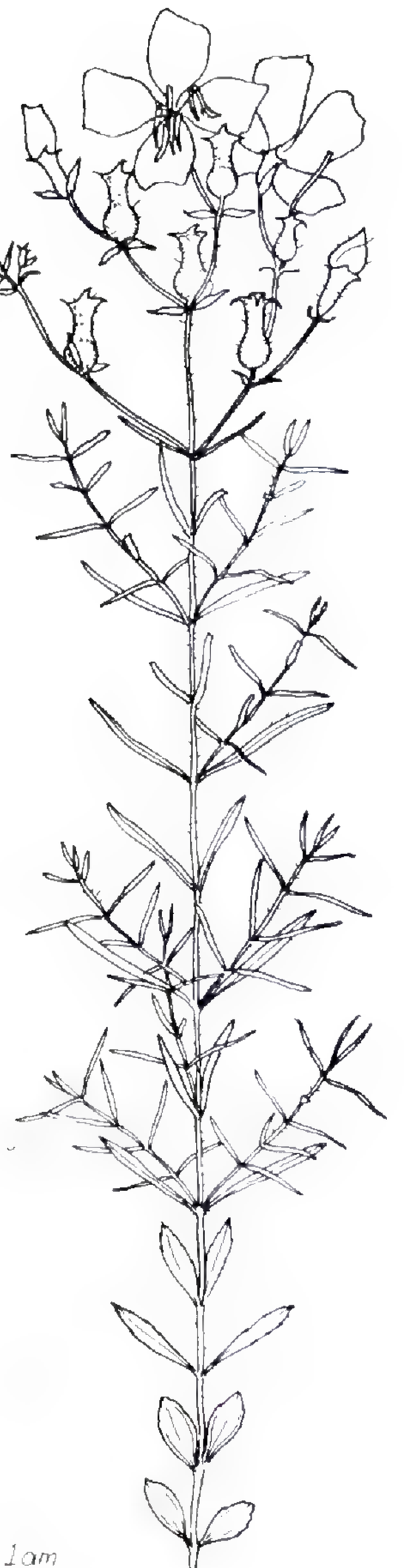


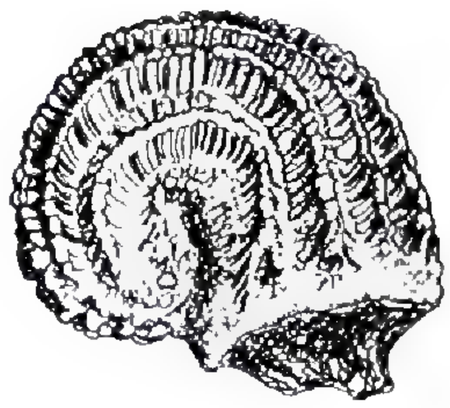
9. RHEXIA MARIANA VAR. VENTRICOSA (p. 410).

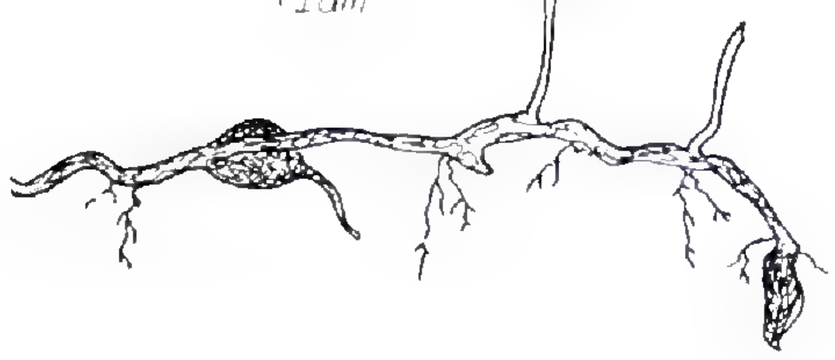


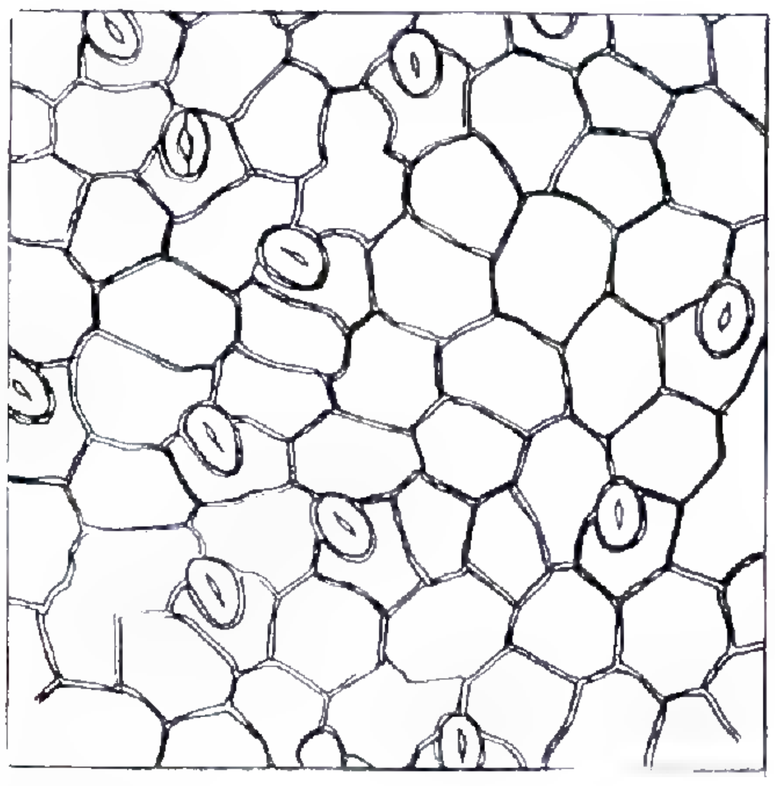
10

10. RHEXIA MARIANA VAR. INTERIOR (p. 410).

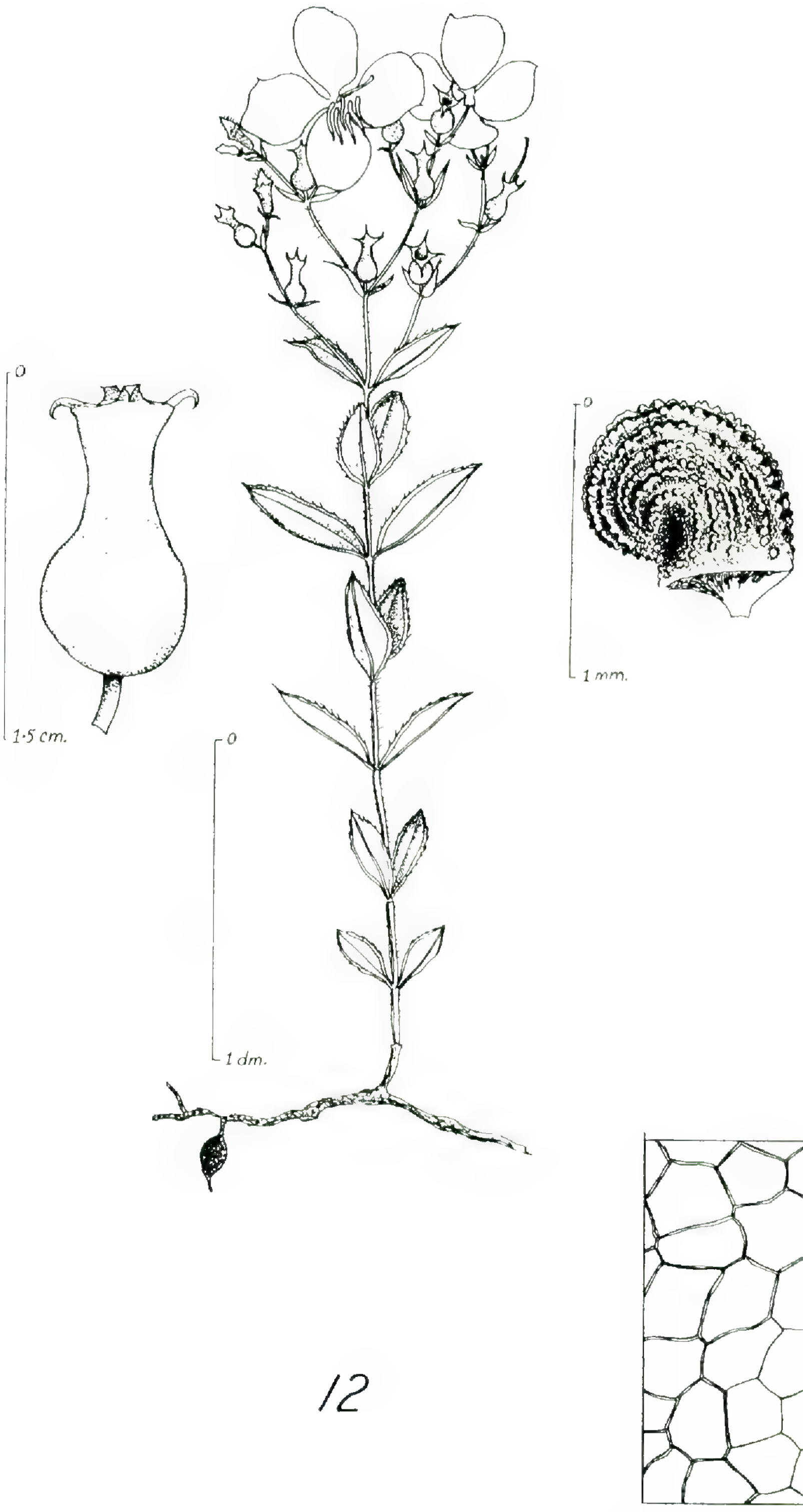


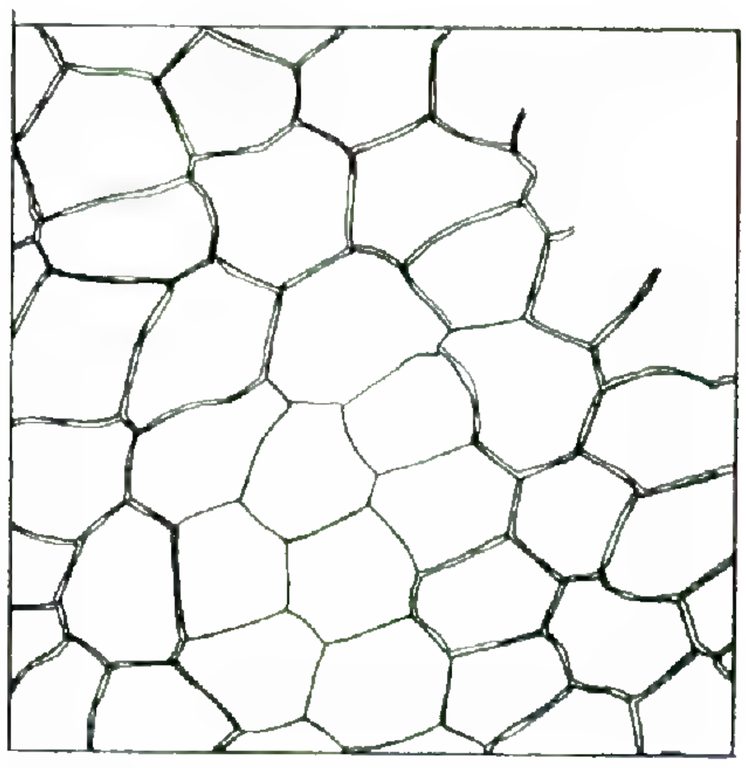






11. RHEXIA CUBENSIS (p. 411).





12

12. RHEXIA NASHII (p. 412).

13

13. RHEXIA ALIFANUS (p. 413).

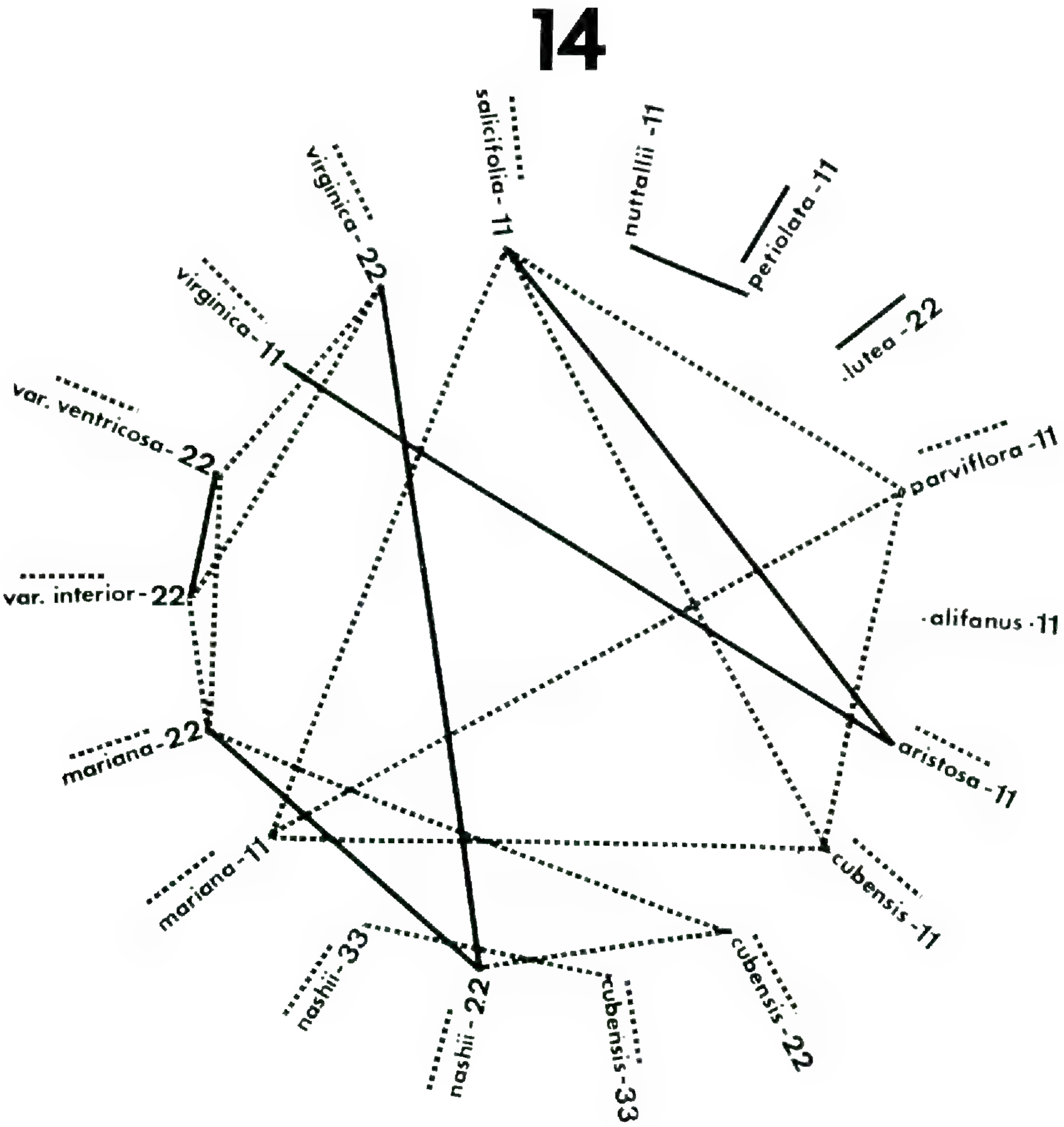
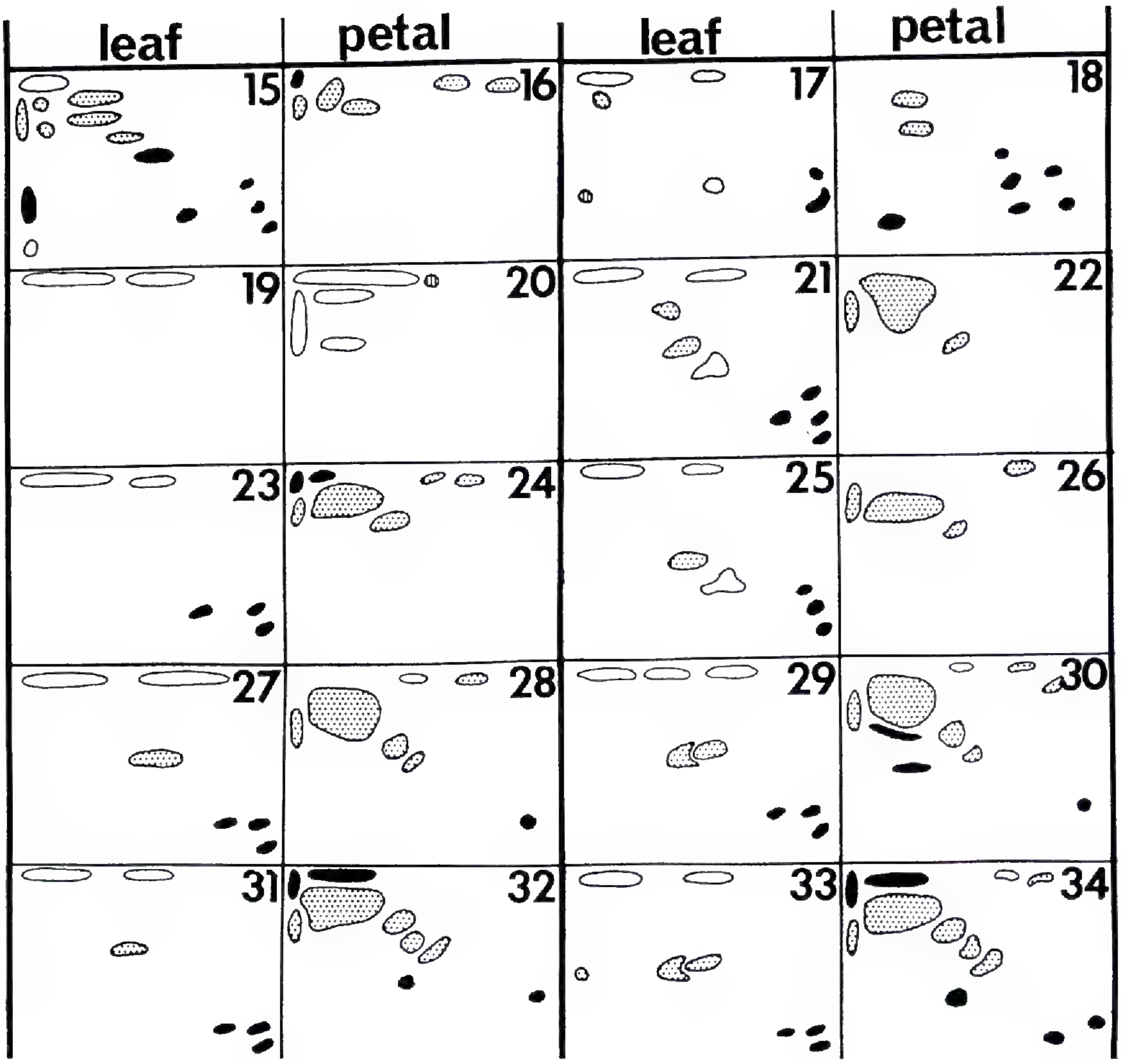
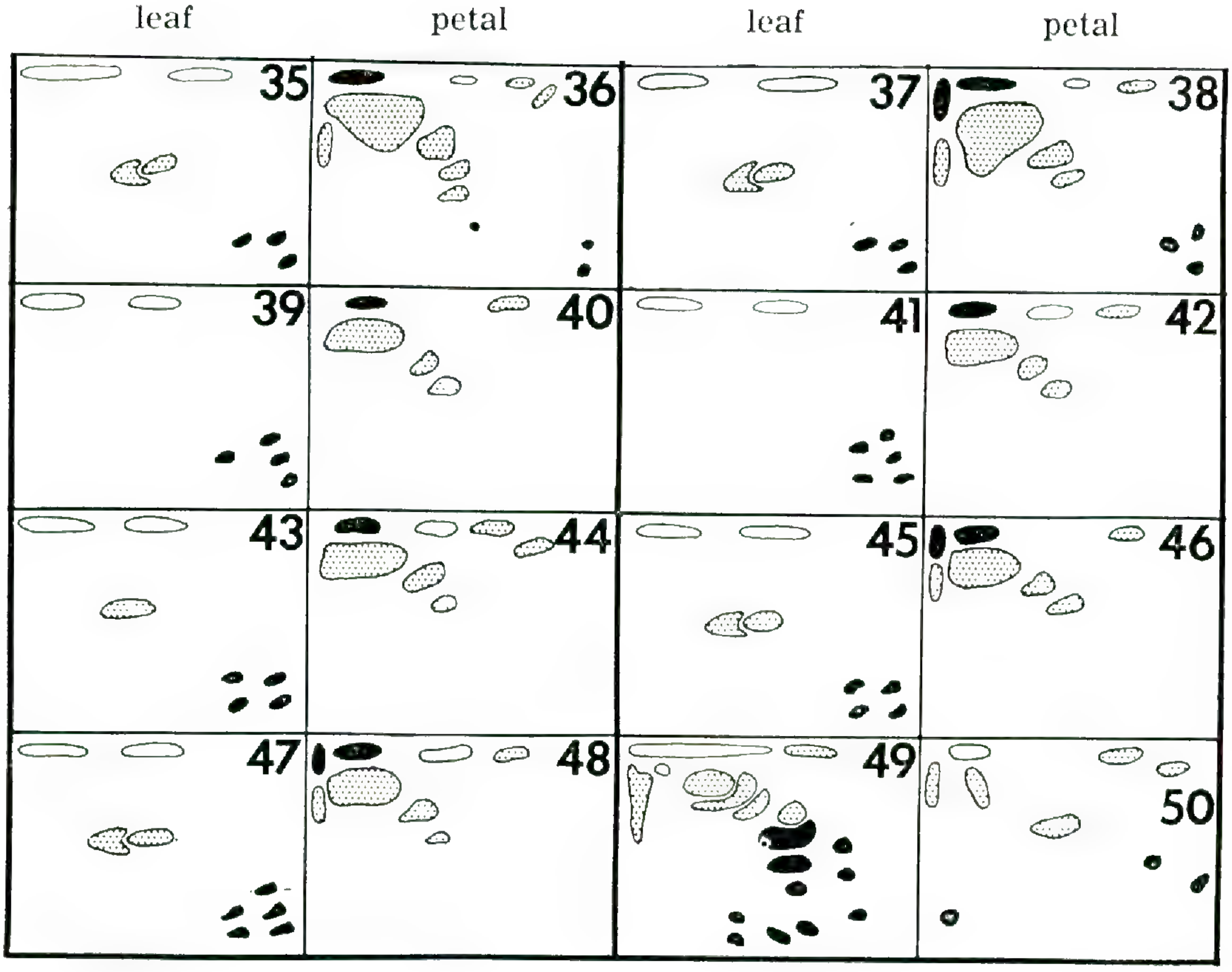


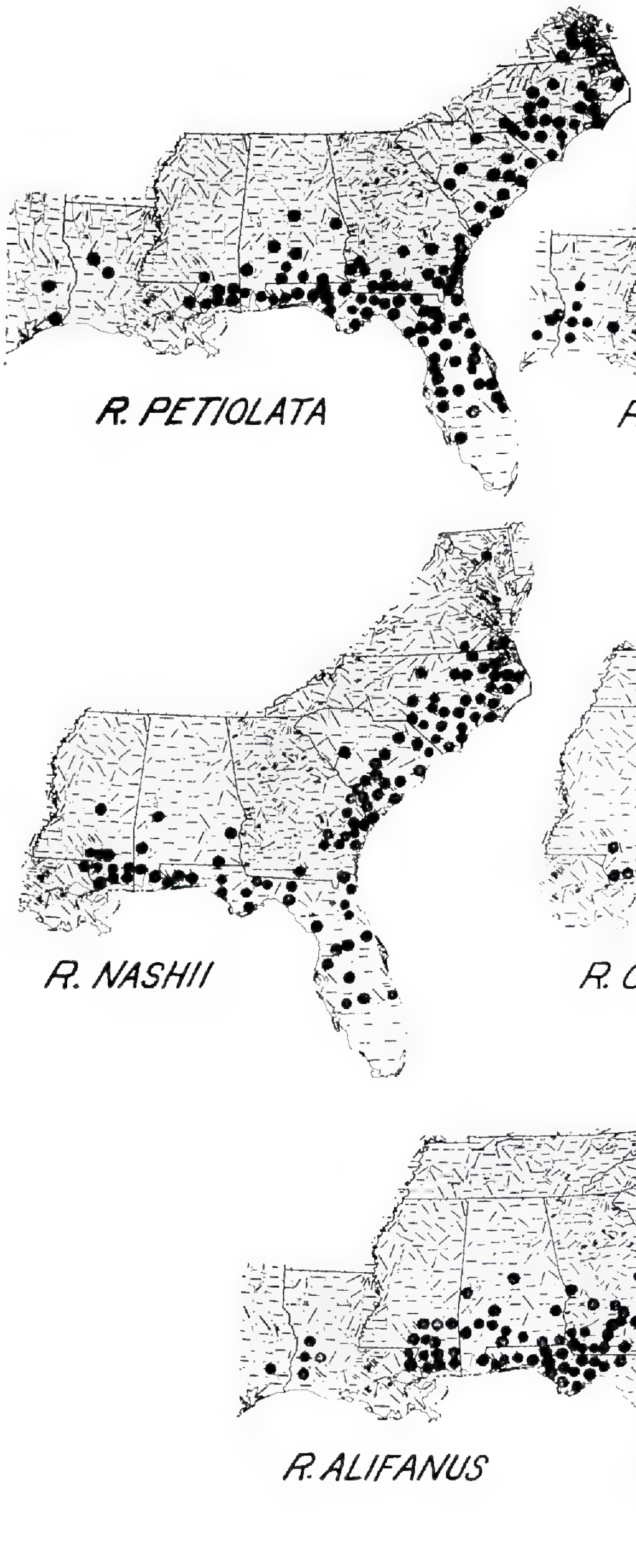
Figure 14. Artificial hybridization in *Rhexia*. Solid lines: seed formed, germinated. Dashed lines: seeds formed, did not germinate (postzygotic isolating mechanism). No connecting lines: seeds not formed (presumably prezygotic or very early postzygotic isolating mechanism). Lines above each species epithet indicate the results of "selfing," as above.



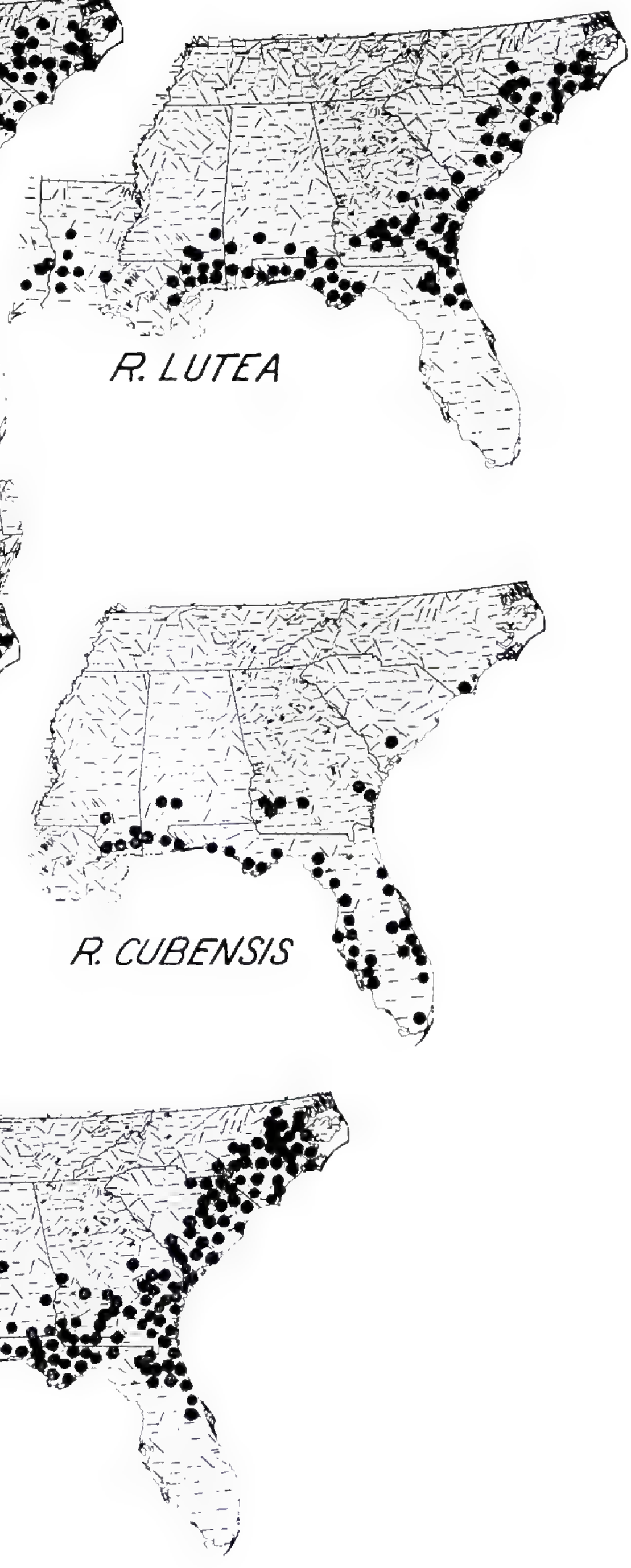
Figures 15-50. Scale drawings of *Rhexia* chromatograms as seen under ultra-violet light in ammonia vapor. Spot origin in upper left of each drawing. Open spots: yellow, dotted spots: purple, black spots: blue, striped spots: orange. Fig. 15, 16: *R. petiolata*; 17, 18: *R. nuttallii*; 19, 20: *R. lutea*; 21, 22: *R. salicifolia*; 23, 24: *R. parviflora*; 25, 26: *R. aristosa*; 27, 28: *R. virginica*, diploid; 29, 30: *R. virginica*, tetraploid; 31, 32: *R. mariana* var. *interior*; 33, 34: *R. mariana* var. *ventricosa*.



Rhexia chromatograms (continued). — 35, 36: *R. mariana*, diploid; 37, 38: *R. mariana*, tetraploid; 39, 40: *R. cubensis*, diploid; 41, 42: *R. cubensis*, tetraploid; 43, 44: *R. cubensis*, hexaploid; 45, 46: *R. nashii*, tetraploid; 47, 48: *R. nashii*, hexaploid; 49, 50: *R. alifanus*.



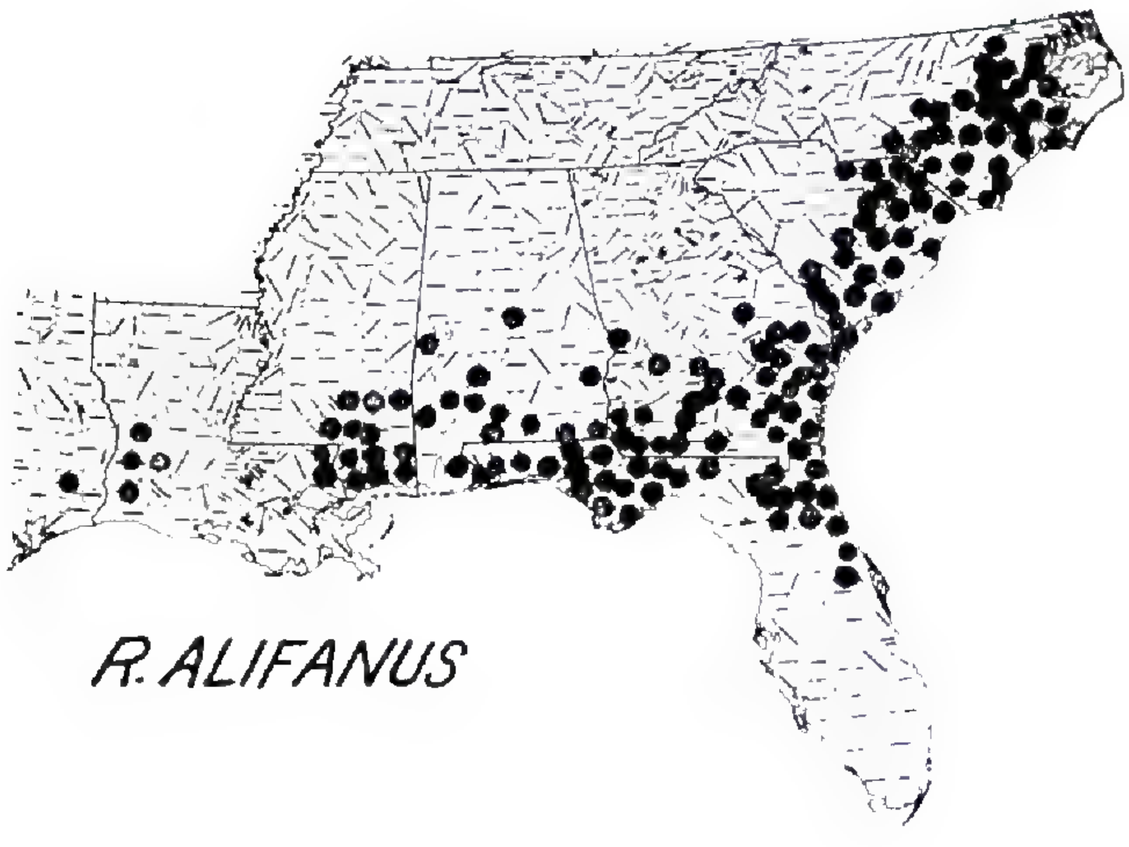
R. PETIOLATA



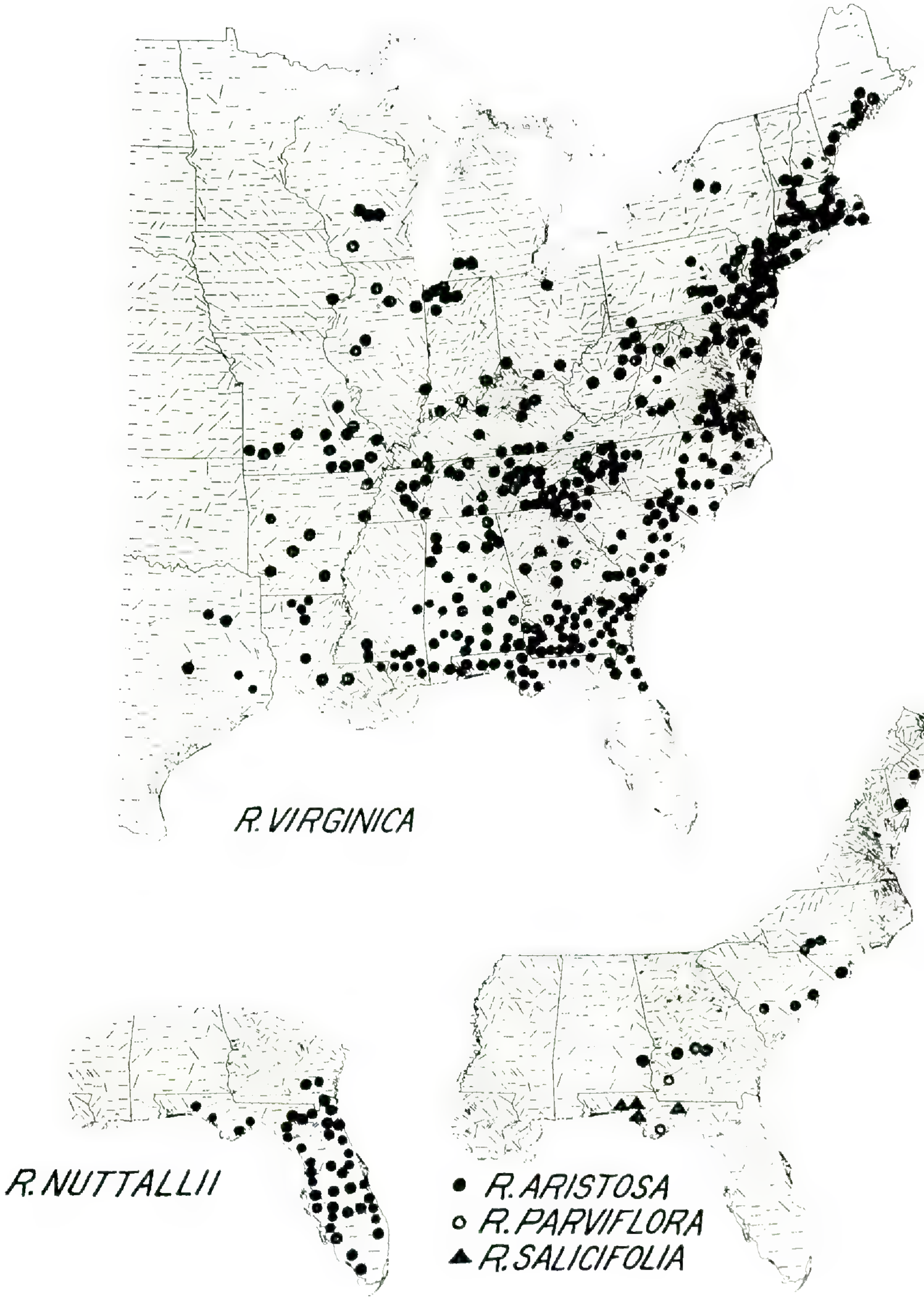
R. LUTEA

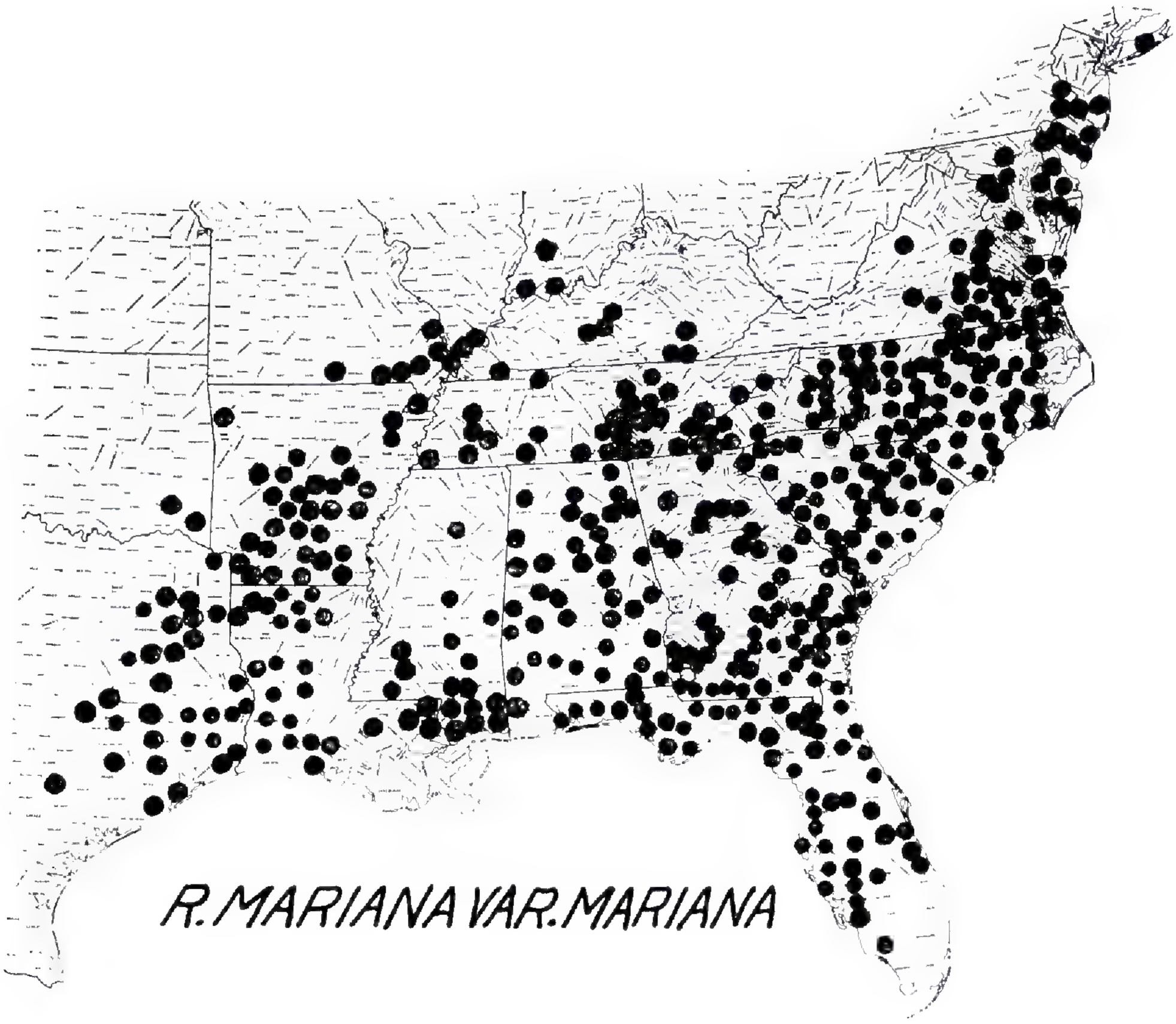
R. NASHII

R. CUBENSIS

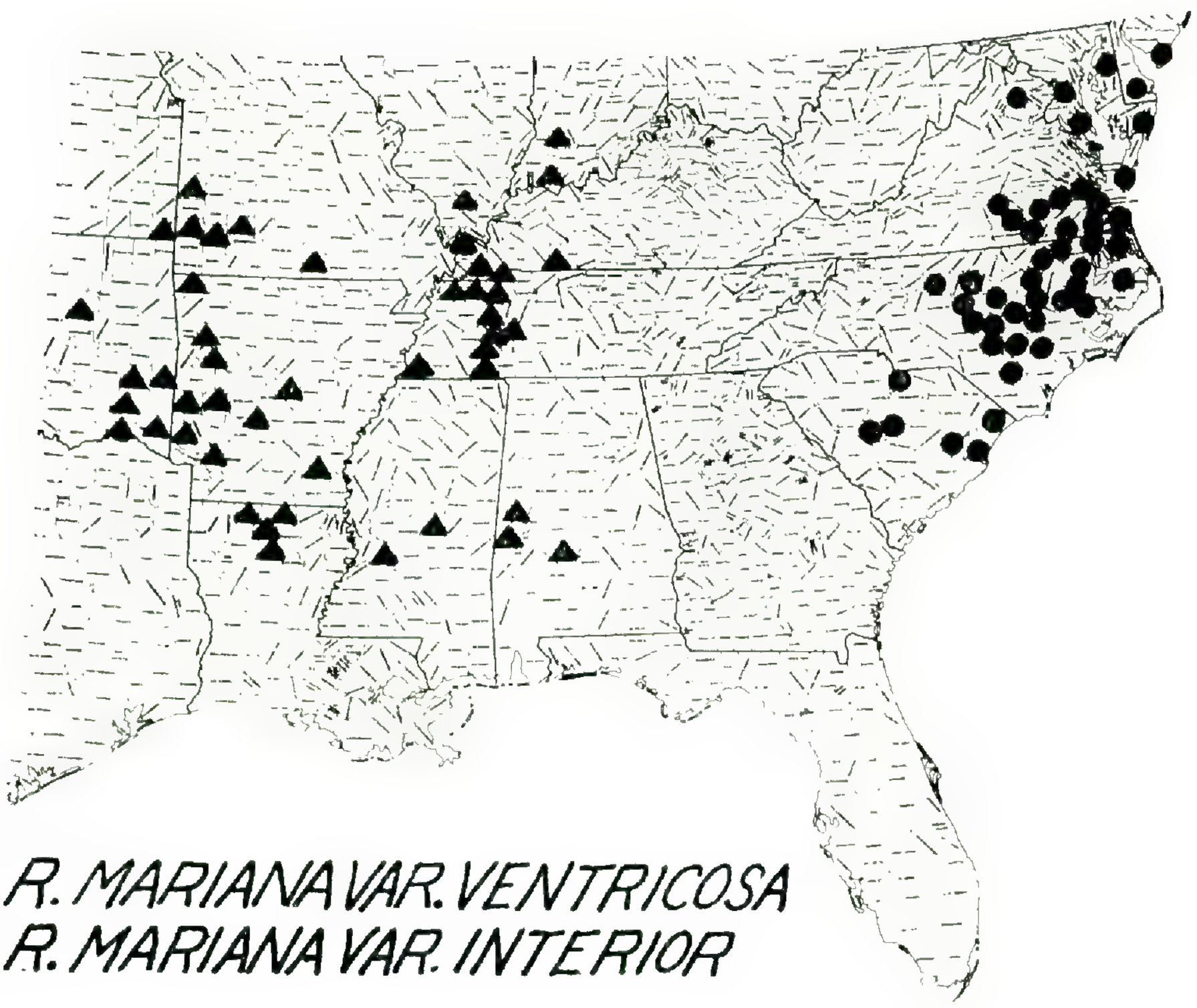


R. ALIFANUS


R. VIRGINICA
R. NUTTALLII
• R. ARISTOSA
○ R. PARVIFLORA
▲ R. SALICIFOLIA



R. MARIANA VAR. MARIANA



○ *R. MARIANA VAR. VENTRICOSA*
△ *R. MARIANA VAR. INTERIOR*

PHLOX AND POLEMONIUM (POLEMONIACEAE) IN THE INTERMOUNTAIN REGION

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Judging from the multiplicity of treatments its members have received, the Polemoniaceae must be regarded as one of the most difficult of plant families. Because of fancied intergradation between genera, Asa Gray lumped many of them under *Gilia*, while Otto Kuntze planned to go still further, and make all the extra-tropical taxa species of *Polemonium* (fortunately without proposing more than a small fraction of the new combinations). Taxonomic splitting has been less extensive, and in the scholarly study of the family by Grant (1959) all pertinent recombinations were made.

A third sort of treatment of taxa has also been applied in the family, their assignment to subjective ("taxonomic") synonymy of prior ones to which they have but slight morphologic and/or ecologic-geographic relationship, which may perhaps be designated taxonomic tossing. The writer has already (1965, 1967) called attention to two cases of this in a regional flora, and after long hesitation feels impelled to discuss the fate in another (Holmgren and Reveal, 1966) of the members of two genera on which he has made thousands of detailed observations and measurements, of which no corrections have been placed on record. In particular, he wishes to reassert his view that endemics are of such importance in the elucidation of speciation and evolution generally that they should be emphasized and not tossed into synonymic obscurity.

Page 84. *Phlox diffusa* Benth. ssp. *subcarinata* Wherry; var. *s.* Peck. *Phlox austromontana* Cov. var. *austromontana.* The latter is a plant of dry habitats with pale, rather coarse, acicular leaves up to 25 mm. long, and a usually nearly glabrous calyx with markedly carinate membranes. In contrast, *P. diffusa* Benth. ssp. *subcarinata* Wherry (var. *s.* Peck) has greener, finer, less acicular leaves under 15 mm. long, in its moister habitats having quite the aspect of other representatives of *P. diffusa*, but unlike them in a weakly carinate calyx. Nothing is gained by making the two "synonymous."

Phlox austromontana Cov. var. *prostrata* E. Nels. (ssp. *p.* Wherry). The Zion Canyon endemic named *P. jonesii* Wherry differs from this in its laxer leaves, deeper-hued corolla, and decidedly longer style. Perhaps it deserves reduction in status, but it is surely too significant to be completely submerged.

Phlox condensata (A. Gray) E. Nels. This taxon is characterized by groups of discrete divergent shoots with appressed dark green leaves, and upwardly glandular pubescence; it grows in the mountains of Colorado above tree-line, or on bleak cliffs somewhat lower, — a typical moist, cold soil "alpine." To reduce to "synonymy" of it morphologically and ecologically distinct desert

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taxa seems utterly unrealistic. *Phlox covillei* has interlacing shoots and broader, hairier, and thicker-margined leaves; it grows in the mountains along the California-Nevada boundary, and if it must be reduced at all, would fall under *P. caespitosa*; but why try to hide endemics?

The most incredible toss in the work under review consists in placing *Phlox griseola* Wherry and its ssp. *tumulosa* Wherry into a table of "synonymy" under *P. condensata* (A. Gray) E. Nelson. In contrast to the features of this high-alpine, listed in the preceding paragraph, these desert Phloxes have, in correspondence with their habitat, thick foliage covered with gray wax—producing the aspect to which the specific epithet refers. The copious coarse pubescence is glandless. Their leaves spread from the stems, which interlace to form striking mats and mounds on the dry sands. Only the most extreme endemicophobe could ever "synonomize" taxa so morphological dissimilar as are these.

Page 85. *Phlox longifolia* Nutt. Surely the six taxonomists who have proposed a total of 19 combinations here reduced to complete subjective synonymy were not all such poor observers that they misinterpreted multiple taxa.

Phlox muscoides Nutt. To toss *P. bryoides* of the same author into subjective synonymy is unreasonable, in that the type specimens of the two do show the differences on which Nuttall based his species segregation. What he did overlook was that his taxon *muscoides* was merely a much reduced state of the prior *P. hoodii* Richardson.

Phlox pulvinata (Wherry) Cronq. As the type of this taxon is merely a reduced alpine extreme of *P. caespitosa* Nutt., assignment of it to species status is deemed unjustified. Moreover, study of the respective types does not support the view that *P. douglasii* Hook. is a "synonym" of true *P. caespitosa* Nutt. They differ widely in leaf shape, texture and indument, in inflorescence-pubescence and in sepal and petal dimensions, — the sort of characters on which the species of the dwarf Phloxes are separable.

Phlox stansburyi (Torr.) Heller var. *brevifolia* (A. Gray) E. Nels. This combination was made at a time when the distinctive diagnostic characters of the taxa concerned were not understood. Actually *Phlox stansburyi* (Torr.) Heller, as shown by its type and by recent collections in its type area, is a long-tubed and long-styled taxon. On the other hand Asa Gray was justified in making the combination *Phlox longifolia* var. *brevifolia*, as these are both relatively short-tubed and short-styled. As taxon *brevifolia* shows no relationship to taxon *stansburyi* in that or any other respect, E. Nelson's combination with which this paragraph is headed is deemed unworthy of acceptance. If on the other hand it is felt that *Phlox longifolia* is already overburdened with varieties, no serious objection can be made to accepting species assignment, as *Phlox grayi* Woot. & Standl., for this taxon so characteristic of the Intermountain Region.

Page 85. *Polemonium*. Presumably because it is a more restricted endemic, *P. chartaceum* is reduced to "synonymy" of *P. eximium* Greene. If such plans prevailed, interesting papers like that on California endemics by Steb-

bins and Major (1965) would never appear.

Polemonium foliosissimum A. Gray. In the writer's 1942 review of this genus, the distinctness of several of the endemics submerged in synonymy in the work under discussion was indicated, but no detailed measurements to support this view were presented. Quite recently, there has been published a study of this series by J. C. Anway (1969) in which this lack is supplied. He has found that three of the seven alleged synonyms are morphologically and geographically so distinct as to deserve at least varietal segregation, with the epithets *alpinum* (Brand) Anway, *flavum* (Greene) Anway, and *molle* (Greene) Anway. (The present writer prefers subspecific status.)

Polemonium occidentale Brand. If one follows the International Code of Botanical Nomenclature, this species epithet cannot validly be attributed to Greene, since he proposed it only provisionally, and moreover based it on two distinct taxa. Its first use without these drawbacks was by Brand in 1907. Some of the synonymy listed consists of mere changes in category; but *P. helleri* Brand and *P. intermedium* (Brand) Rydb. are erroneously included here, belonging to divisions of the genus with corymbose rather than thyrsoid inflorescence.

Polemonium pulcherrimum Hook. var. *pulcherrimum*. This is the westernmost of the tufted members of the genus, barely entering, at Mt. Rose, Nevada, the Intermountain Region. The morphologic and geographic relations in this group have recently been discussed on the basis of extensive observations and measurements by the writer (1967). Most of the "synonyms" tabulated represent species which are but distantly or not at all related. The restricted endemic *P. nevadense* Wherry does not exhibit a single *pulcherrimum*-like attribute; and one might suppose that Intermountain botanists would like to have a taxon so unique to their region emphasized rather than suppressed.

Polemonium pulcherrimum Hook. var. *calycinum* (Eastw.) Brand. Confusion reigns under this heading also. It is hard to see how anything can be gained by reducing the commonest, best marked Californian member of the genus, *Polemonium californicum* Eastw., to "synonymy" of an epithet based on a solitary specimen of a monstrosity, to which it shows no resemblance anyway. The type of Miss Eastwood's Californian taxon does not approach the Intermountain Region, but its relative *P. californicum* subsp. *columbianum* (Rydb.) Wherry, 1967, does in Idaho. This taxon is morphologically closer to the eastern *Polemonium reptans* L. than to any variant of *P. pulcherrimum*, but there seems no need to start making new name-combinations to bring this out.

Polemonium pulcherrimum Hook. var. *delicatum* (Rydb.) Cronq. On the basis of the morphologic and geographic features discussed by the writer (1967), this combination is wholly inacceptable.

Critical remarks could be made under still other taxa, but enough has now been said to indicate that the treatment of the Polemoniaceae in the work under discussion needs extensive revision.

American taxonomists are planning a counterpart to the currently appearing *Flora Europaea*. If this is not compiled more realistically than have been some of our recent regional floras, it will fail to attain that status.

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NOTES

SAGITTARIA GUAYANENSIS (ALISMACEAE) IN LOUISIANA: NEW TO THE UNITED STATES.—According to Bogin, in his "Revision of the genus *Sagittaria* (Alismataceae)" (Mem. New York Bot. Gard. 9: 179-233. 1955.), *Sagittaria guayanensis* H.B.K. ssp. *guayanensis* ranges "Throughout tropical America, except in the higher mountains." His distribution map indicates that the plant occurs, in North America, from west-central Mexico south through Panama. On the basis of the following collection, *S. guayanensis* ssp. *guayanensis* may now be added to the flora of the conterminous United States: frequent weed in rice field, rice experiment station, 2.5 miles NE of Crowley, Acadia Parish, Louisiana, *Thieret 31870*, 18 August 1969. Among United States *Sagittaria* (including *Lophotocarpus*), *S. guayanensis* is distinctive by its triangular sepals that are strongly keeled distally and that are closely appressed in flower and fruit; by its flowers, which have a ring of several functional stamens around the gynoecium; and by its leaves, which are broadly ovate or elliptic, are deeply cordate at the base, and are floating. In size and shape, the leaves are reminiscent of those of *Nymphoides cordata*. The flowers in anthesis are the only part of the plant that is emersed. Their petals are white, with a dull reddish spot just above the base, and are 12-15 mm long. The achenes are greenish and strongly tuberculate when mature. The large receptacle is white, making, after shedding of the achenes, a striking contrast to the persistent green sepals. A passable illustration of *S. guayanensis* is given in *Flora Malesiana*, Ser. 1, Vol. 5 (1957), p. 328. *Sagittaria guayanensis* is represented in the Old World by ssp. *lappula* (D. Don) Bogin, which is distinguished from the New World plant by characteristics of the achenes. Voucher specimens of the Louisiana collection are to be distributed through the 1969 Southern Appalachian Botanical Club exchange.—*John W. Thieret, University of Southwestern Louisiana, Lafayette 70501.*

RUMEX OBOVATUS AND RUMEX PARAGUAYENSIS (POLYGONACEAE) IN LOUISIANA: NEW TO NORTH AMERICA.—Among collections of Louisiana *Rumex* sent last year to Dr. K. H. Rechinger for determination were specimens of two species whose identity had long baffled me. The suspicion that these were *R. obovatus* Danser and *R. paraguayensis* D. Parodi was confirmed by Dr. Rechinger. The species are well-described, and their fruiting structures are illustrated, in Rechinger's "Die sud- und zentral amerikanischen Arten der Gattung *Rumex*" (Arkiv for Botanik 26A, no. 3: 1-58. 1933). Native to Argentina and Paraguay, they are adventive in Europe but seemingly have not been previously reported from North America. Both species are, according to Rechinger, annual or biennial. *Rumex obovatus* behaves as an annual in Louisiana. Both species possess valve margins that are prominently toothed, a characteristic shared, in southeastern United

States, only by *R. fueginus*, *R. obtusifolius*, and *R. pulcher*. The teeth of *R. fueginus* are longer than the width of the valves; those of *R. obovatus* and *R. paraguayensis* are shorter. *Rumex paraguayensis* differs from *R. obtusifolius* and *R. pulcher* by its smaller valves (only 2.5-3 mm long) and by its not possessing well-separated verticels of flowers. *Rumex obovatus* is reminiscent of both *R. obtusifolius* and *R. pulcher*, which are, however, allegedly perennial species. Typically each of the valves of *R. obovatus* bears a grain; usually only one valve of *R. obtusifolius* does so, at least among almost all North American specimens of it. Verticels of *R. obovatus* contain more flowers (20-50) than those of *R. pulcher* (10-15) and are larger in fruit (ca. 13-16 mm vs. 10 mm or less).

In Louisiana, *R. obovatus* has been collected in Cameron (*JWT 19819, 29363*), Jefferson Davis (*JWT 26359*), St. Bernard (*R. J. Lemaire 320*, misidentified as *R. obtusifolius*), St. Tammany (*Lemaire 1040*, misidentified as *R. obtusifolius*), and Tangipahoa (*JWT 19689*) parishes; *R. paraguayensis*, only in St. Tammany Parish (*JWT 27002*). *Rumex obovatus* almost certainly occurs in coastal Texas—one of my Cameron Parish collections was made within 150 feet of the Texas border, there the Sabine River.

Voucher specimens are on file in the herbaria of the University of Southwestern Louisiana and Southern Methodist University. My collections were made in connection with the Louisiana Flora Project, supported by a grant (GB-4671) from the National Science Foundation.—*John W. Thieret, University of Southwestern Louisiana, Lafayette 70501.*

BAPTISIA LACTEA (RAFINESQUE) THIERET, COMB. NOV. (LEGUMINOSAE).—Based on *Dolichos lacteus* Rafinesque, Fl. Ludov. 103. 1817. *Baptisia leucantha* Torrey et Gray, Fl. N. Amer. 1: 385. 1840. Rafinesque's description leaves no doubt as to the identity of his *Dolichos lacteus*. The *Florula Ludoviciana* is essentially an abridged, Latin and English translation of the "Flore Louisianaise" that is part (Vol. 3, pp. 311-538) of C. C. Robin's *Voyages dans l'Interieur de la Louisiane* (1807). The protologue composed by Rafinesque was drawn up not only from the brief description in the "Flore" but also from a fuller account of the plant given by Robin on pages 267-268 of volume 3 of *Voyages*. It is probable that Robin saw *Baptisia lactea* during his journey to "the country of the Atakapas," the prairie region of Louisiana, where the plant is a frequent one.—*John W. Thieret, University of Southwestern Louisiana, Lafayette 70501.*

TRIFOLIUM VESICULOSUM (LEGUMINOSAE) IN MISSISSIPPI AND LOUISIANA: NEW TO NORTH AMERICA.—A strange clover, conspicuous because of its large heads, was collected by me in Louisiana this past summer and was tentatively identified as *Trifolium vesiculosum* Savi. During a visit to Southern Methodist University, I mentioned the find to Dr. Shinners, who promptly showed me a Mississippi specimen of the same species that

had been collected by Mr. F. H. Sargent just 4 days before I made my collection. The Sargent specimen had been "Det. by New York Botanical Garden" as *T. vesiculosum*. These collections are apparently the first for the species in North America. They are a good match for a Southern Methodist University herbarium sheet of *T. vesiculosum* from Italy. According to *Flora Europaea* (Vol. 2, p. 164. 1968), the species ranges from "S. Europe from Corse eastwards, extending northwards to Hungary." *Trifolium vesiculosum* is perhaps most easily identifiable by its characteristic fruiting calyx. The following description points out the salient features of the species. Annual with decumbent stems; leaves palmately trifoliolate with elliptic to lanceolate, spinose-denticulate leaflets; heads pedunculate, globose to oblong, becoming 6.5 cm long and 3.0 cm wide; flowers sessile, bracteate, the bracts about as long or somewhat shorter than the calyx tube; calyx glabrous, much inflated in fruit, contracted at the mouth, with many prominent longitudinal veins, these connected by many less prominent transverse veins; corolla white, becoming pink in age, much exceeding the calyx. The data for the two North American collections of *T. vesiculosum* are: MISSISSIPPI. Pearl River County: 3 mi. se. of Picayune, 11 June 1969, *Sargent 9858* (SMU). LOUISIANA. Caddo Parish: 2 mi. nw. of Vivian, along Vivian-Atlanta road, 15 June 1969, *Thieret 31282* (DUKE, LAF, SMU).—*John W. Thieret, University of Southwestern Louisiana, Lafayette 70501.*

ACALYPHA GRACILENS GRAY VAR. DELZII L. MILLER, VAR. NOV. (EUPHORBIACEAE).—Folia linearia, raro subcrenata ad integra, 4—6-plo longa quam lata, petiolo 0.1 laminae. Spicae mares saepe bracteam foemineam multo excedentes. Semina plerumque 1.5 mm. longa. HOLOTYPE. ARKANSAS, Hot Spring Co.: Bismarck, *Delzie Demaree 39432*, July 14, 1957 (SMU). Leaf blades linear, rarely slightly crenate to entire, 4—6 times as long as broad; petiole about 0.1 as long as leaf blade. Staminate spikes frequently much surpassing the pistillate bract. Seed mostly 1.5 mm. long. DISTRIBUTION: Dry sandy soil, Texas (Bowie south to Gonzales, Travis, and Liberty counties) east into central Louisiana and north into southwestern Arkansas. During my work on a revision of the North American species of *Acalypha*, I recognized this new variety and have annotated specimens with the name here validated. Var. *gracilens* has ovate to lanceolate leaf blades, margins usually crenate, with petioles about 0.25 as long as blades, staminate spikes usually not exceeding the pistillate bract, seeds mostly 1.5 mm. long.—*Lillian W. Miller, Department of Biology, Jacksonville University, Jacksonville, Florida 32211.*

PIERIS PHILLYREIFOLIA (Hook.) DC. (ERICACEAE) IN SOUTH CAROLINA.—Radford *et al.* in "Manual of the Vascular Flora of the Carolinas" (1968) do not credit this vine with occurring in the Carolinas, and Duncan's "Woody Vines of the Southeastern States" (Sida vol. 3 no. 1, 1967) gives Georgia as its northern limit (map, p. 69). Citation of the following speci-

mens, FSU, will serve to record its occurrence in South Carolina. COLLETON COUNTY: shrub, climbing under the bark of *Taxodium ascendens* and with leafy laterals then growing outward along the tree trunk; swamp, Moselle Swamp, W of Islandton; *R. K. Godfrey 68534*, June 21, 1969. BERKELEY COUNTY: cypress swamp, growing under and from the bark of *Taxodium ascendens*; 4.6 miles S of the Santee River along U.S. rt. 17; *R. K. Godfrey 68211* with Robert & John Lazor, Sept. 4, 1968.—*R. K. Godfrey, Florida State University, Tallahassee, Florida 32306.*

DOPATRIUM JUNCEUM (SCROPHULARIACEAE) IN LOUISIANA.—An Asiatic annual emergent aquatic, *Dopatrium junceum* (Roxb.) Hamilt. in Benth. has been recorded in North America only from California, where it is a rice-field weed. On the basis of the following collection, Louisiana can now be added to the species' North American range: rice-field weed, rice experiment station, 2.5 miles NE of Crowley, Acadia Parish, *Thieret & Dike 31869*, 14 August 1969. With a population of thousands of individuals, the species was common locally but hardly conspicuous. It grew in mud at the water's edge or, much more usually, in water up to about 1 foot deep and mostly among *Chara* sp. The plants were simple or branched. The flowers were, for the most part, borne on the emergent parts of the plants although a number of fruits were developing under water. Illustrations of *D. junceum* and its various parts (including the unilocular ovary that, in the Scrophulariaceae, is somewhat anomalous) are given in Mason's *A Flora of the Marshes of California* (unfortunately, among the illustrations those of flowers are upside-down and that of a cross-section of the ovary has been rotated 90 degrees from its actual position). Voucher specimens are to be distributed through the 1969 Southern Appalachian Botanical Club exchange.—*John W. Thieret and David H. Dike, University of Southwestern Louisiana, Lafayette 70501.*

LOUTERIDIUM TAMAULIPENSE A. RICHARDSON (ACANTHACEAE), A NEW SPECIES FROM NORTHEASTERN MEXICO.—Frutex subligneus 2.0—2.5 m. altus, caulibus veteribus prostratis radiciferis. Folia decussata opposita, petiolis 4—7 cm. longis, laminis ovatis attenuatis (basi acutis vel attenuatis) integris vel denticulatis glabris 6.0—10.5 cm. latis 15-23 cm. longis. Inflorescentiae internodus imus glaber elongatus, ceteri viscidi pubescentes; cymae geminae bracteis caducis in panicula terminali. Calyx trilobus pubescens, lobis aequalibus, planis, lanceolatis, 3.6 cm. longis, tuba 2—3 mm. Corolla bilabiata quinqueloba lobis superioribus 2 revolutis inferioribus 3 contortis; tuba 3 mm. longa, faux gibbosa 2.5 cm. longa, lobi 3.0—3.2 cm. longi. Stamina 2 glabra quoque partim ad staminodium pubescens coalescens; antherae exsertae 1.5 cm. longae. Ovarium sessile glanduloso-pubescens 7 mm. longum; stylus 6.5 cm. longus; stigma inaequaliter bilobum. Capsula paulum compressa 3.3 cm. longa; semina 16—18 discoidea diametro 4—5 mm.

Soft-woody shrub 2.0—2.5 m. tall; old stems prostrate and sprawling on

rocks, sending out adventitious roots; current season's growths arising singly and erect from the nodes. Leaves simple, opposite, decussate, glabrous; petiole 4—7 cm. long; blade ovate, 6.0—10.5 cm. wide, 15—23 cm. long, entire to finely denticulate, attenuate at apex, acute to attenuate at base, with cystoliths on both sides but more prominent on the upper surface, especially along midrib and veins, the upper surface dark green, the lower light green and more prominently veined. Inflorescence a terminal, bracteate, cymose panicle, with cymes arising in pairs from each node, subtended by caducous bracts; first internode of axis glabrous, elongate, about five times the length of the second internode, with a pair of glabrous, sessile, bract-like leaves subtending the first pair of cymes; axis and branches at and above first node moderately viscid and pubescent with several-celled white hairs. Calyx greenish white, pubescent within and without, enclosing the unopened corolla but enclosing the fruit more tightly, divided 2—3 mm. above base into three equal, lanceolate, plane lobes 1.1 cm. wide by 3.6 cm. long, with cystoliths prominent only toward the base. Corolla greenish white, laterally compressed, lightly pubescent, 2-lipped with two revolute lobes above and three contorted ones below; tube 3 mm. long, 7 mm. in diameter; throat gibbous, 2.5 cm. long, 2.3 cm. across; lobes 3.0—3.2 cm. long, imbricate in bud. Stamens 2, glabrous, each partially coalescent with a pubescent staminodium, adnate to the corolla and alternate with the lobes, 6.5 cm. long; anthers exserted, 1.5 cm. long, with 2 locules opening longitudinally. Ovary sessile, slightly flattened, 7 mm. long, 1.5 mm. in diameter, pubescent with glandular hairs especially above (extending onto the lower part of the style); style 6.5 cm. long; stigma bilobed, the lower lobe slightly larger than the upper. Fruit a loculicidal somewhat flattened capsule 3.3 cm. long, 0.8 cm. wide; retinacula 3 mm. long, falcate. Seeds 16—18, discoid, 4—5 mm. in diameter, thickened for about 0.5 mm. around margin.

HOLOTYPE (mounted on 4 sheets): MEXICO, Tamaulipas: rocky slope in a wet forest, 1200 ft. (370 meters) altitude, about 3 miles (5 km.) by road northwest of Gomez Farias, *Alfred Richardson 1388*, 30 June 1969 (TEX; isotypes to be distributed).

The genus consists of eight species. *L. tamaulipense* is easily distinguished from *L. chartaceum* Leonard and *L. koelzii* McVaugh & Miranda, both of which have four stamens; from *L. donnell-smithii* Watson, *L. mexicanum* (Baill.) Standl., *L. conzattii* Standl., and *L. parayi* Miranda, which have conduplicate dorsal lobes of the calyx; and from *I. costaricense* Radlk. & Donn.-Sm., which is completely glabrous and has persistent bracts in the inflorescence.—*Alfred Richardson, Department of Botany, University of Texas, Austin, Texas 78712.*

HETEROTHECA SCABRELLA (T. & G.) LONG, COMB. NOV. (COMPOSITAE).—Based on *Chrysopsis scabrella* T. & G., Fl. N.A. 2: 255. 1842.—*Robert W. Long, Department of Botany and Bacteriology, University of South Florida, Tampa, Florida 33620.*

MARSHALLIA CAESPITOSA VAR. SIGNATA (COMPOSITAE) IN THE OUACHITA MOUNTAINS OF ARKANSAS—*Marshallia caespitosa* Nutt. ex DC. var. *signata* Beadle & Boynt. (Redfearn 23998) was collected in Perry County on the bank of Maumelle River, ca ¼ mile south of Williams Junction, sect. 26, T. 3 N., R. 17 W. on 20 June 1968. Identification has been verified by Dr. R. B. Channell and voucher specimens are deposited in the herbaria of Southwest Missouri State College and Vanderbilt University. This is apparently the first report of this taxon from Arkansas and is significant in that the above locality is intermediate between its range in Texas and a disjunct locality in Ozark Co., Missouri.—*Paul L. Redfearn, Jr., Southwest Missouri State College, Springfield, Mo. 65802.*

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STUDIES ON BIGELOWIA (ASTEREAE, COMPOSITAE). 1. MORPHOLOGY AND TAXONOMY[1]

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INTRODUCTION

The genus *Bigelowia* (the rayless goldenrods) was established by DeCandolle in 1836, but the orthographic variant *Bigelovia* was generally used for the next 50 years. The genus as presently recognized contains only two species, both native to southeastern United States, but historically all species of *Chrysothamnus*, many of *Haplopappus*, and one each of *Solidago* and *Eupatorium* were included. Gray (1873), in his commentary on Bentham and Hooker's treatment of Compositae in Genera Plantarum (1873), retained the wide generic limits for *Bigelowia* but pointed out that those taxa referrable to Nuttall's *Chrysothamnus* were more akin to *Haplopappus* than to the original *Bigelowia*; they, in turn, were more like *Solidago*, section *Euthamia*. Recent studies (Shinners, 1951; Kapoor and Beaudry, 1966) support the generic distinctness of *Euthamia*.

In 1895, Greene argued for the re-establishment of *Chrysothamnus* for the rabbitbrushes and followed Britton's (1894) adoption of Rafinesque's name *Chondrophora* for the rayless goldenrods, since *Bigelowia* DC. was untenable as a later homonym. He also suggested that if *Chrysothamnus* and *Chondrophora* (*Bigelowia*, sensu stricto) were closely related, then his genus *Petradoria* would be intermediate in the relationship.

The name *Bigelowia* DC. was conserved for the rayless goldenrods at the Sixth International Botanical Congress of Amsterdam in 1935 (Camp et al., 1947). The generic name *Bigelowia* Rafinesque was rejected, and *Chondrophora* became a synonym.

METHODS AND MATERIALS

Morphological features of all available material were studied; however, several collections representing the geographical range for each taxon were selected and studied in great detail (cf. Table 2). References to measurements in the morphology section of this paper are based on that group of specimens.

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Measurements for vegetative features were from the largest of each unit (e.g., stem or leaf length or cauline leaf number) for each collection. Determining the average length of the several basal leaves per plant would be more difficult than measuring the longest and, therefore, probably less accurate for comparisons among the taxa. Average measurements for floral features were obtained as outlined in Anderson (1964).

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MORPHOLOGY

Bigelowia nuttallii ("*B. virgata*") has been known to biology for over 150 years, but it has been infrequently collected and poorly understood (as is much of the southeastern flora; see Duncan, 1953). Many botanists, following Torrey and Gray (1842) and Britton (1894), have considered it simply as a narrow-leaved variety of the widespread *B. nudata*. It was also distinguished by its rather restricted habitat preference (Harper, 1906b, 1911; Brown, 1945). When grown in the greenhouse in several different soil mixtures over a period of years, *B. nuttallii* maintains its distinctive foliage. Actually, the two species are distinct in several aspects of morphology. Their distinctness is also indicated by anatomical and cytological studies in progress. There is, however, infraspecific variability in *B. nudata*; a new subspecies, *B. n.* subsp. *australis*, is described in this paper.

Vegetative morphology. Averages for major diagnostic features are summarized in Table 1 for the three entities; the ranges of variability for those features are reported in the systematic treatment. Additional comments are made in the text.

Rhizomes and short, narrow caudices characterize *B. nuttallii*; whereas plants of *B. n.* subsp. *nudata* are cespitose with a short, stocky caudex up to 10 mm wide. Occasionally, layering by sediments results in an elongated, rhizome-like caudex. In *B. n.* subsp. *australis*, conditions are intermediate: caudices are elongate, only moderately thickened, and frequently connected by short rhizomes.

Average stem height of *B. n.* subsp. *australis* is intermediate to that of the other taxa; however, extremes for the genus (86 and 22 cm) are found in this subspecies. Although stems of *B. nuttallii* are usually shorter than those of *B. nudata*, the former has more leaves. Distribution of cauline leaves warrants further attention because of the complex phyllotaxies present.

Leaf shape represents one of the more obvious differences among the taxa (Table I). Nevertheless, *B. nuttallii* from Texas can produce broadly spatulate leaves (up to 6.5 mm wide). In *Cory 50592* (SMU) and *Ripple 51-563* (KANU), the first basal leaves are typically linear, and the terminal ones of

TABLE 1. COMPARATIVE VEGETATIVE MORPHOLOGY IN BIGELOWIA (data represent averages of largest units)

Feature	*B. nuttallii*	*B. n. nudata*	*B. n. australis*
caudex length, cm	1.03	1.13	3.14
stem height, cm	39.5	59.2	48.3
stem leaf number	17.4	11.2	10.3
basal leaf length, cm	9.7	7.7	13.1
basal leaf width, mm	1.2	7.3	3.3
first stem leaf length, cm	7.1	5.0	9.5
first stem leaf width, mm	1.0	4.0	2.5
third stem leaf length, cm	5.7	3.4	5.2
third stem leaf width, mm	0.9	2.1	1.8

the rosettes are broad. *Anderson 3173* (KSC) produced spatulate leaves after being transplanted to a greenhouse in Manhattan, Kansas. Plants of the same population raised in the greenhouse from seed had the typically narrow leaves seen in the original field collection. In all plants of *B. nuttallii* with the broadened basal leaves, the cauline leaves are typically narrow, and features of the inflorescence are constant also. In all taxa basal leaves are frequently withered by flowering time; this is most pronounced in *B. n. australis*.

Floral morphology. Data for floral features are compiled in Table 2. Those for selected taxa of *Euthamia* are listed in Table 3 for comparison; for *Petradoria*, see Anderson (1963).

Inflorescences are corymbose and flat-topped in the rayless goldenrods. Those of *B. nuttallii* are noticeably smaller. Using measurements of the longest inflorescence branch for each collection of Table 2, the following averages are derived: *B. nuttallii*, 8.5 mm; *B. n.* subsp. *nudata*, 11.4; and *B. n.* subsp. *australis*, 10.8.

Heads of *B. nuttallii* are relatively narrower than those of *B. nudata*. The width/length ratio for involucres of *B. nuttallii* averages 0.26, but averages 0.34 for *B. nudata*.

Individual involucral bracts of *B. nuttallii* are narrower than those of *B. nudata*. The bracts are often aligned vertically, but the alignment varies greatly within each taxon. For example, in *B. n.* subsp. *australis* they are strongly aligned in *Godfrey 65642* (FSU), weakly so in *Small & Carter 1026* (NY), but not at all in *Kral 3949* (FSU). Such variation is contrary to the statement by Hall and Clements (1923, p. 157) that there is no tendency for involucral bracts to form vertical rows in *Bigelowia*.

The receptacle is either alveolate or with a central cusp similar to that frequently found in *Petradoria* (Anderson, 1963) or the setaceous receptacle characteristic of *Euthamia* (Table 3). As in *Petradoria*, the geographic occurrence of such a receptacle in the rayless goldenrods is sporadic.

TABLE 2. AVERAGED DATA FOR SELECTED FLORAL FEATURES IN BIGELOWIA

taxon and collection data	*bract number*	*involucral length, mm*	*involucral width, mm*	*receptacular cusp, mm*	*flower number*	*corolla length, mm*	*corolla lobe length—total length, %*	*stigmatic area—total style branch, %*
B. nuttallii								
GEORGIA: Washington Co.: 3 mi N Harrison, *Pyron & McVaugh 3094* (GA)	11.8	6.7	1.6	0.48	3.7	4.1	33.3	64.8
GEORGIA: Coffee Co.: "The Rocks," 8 mi N Broxton, *Montgomery 1052* (GA, KSC)	12.5	7.1	1.8	0.52	3.2	5.1	35.6	58.9
GEORGIA: Turner Co.: 6 mi S Arabi, *Anderson 3089* (KSC)	11.0	7.5	1.4	0.42	3.0	4.2	31.9	59.7
GEORGIA: Rockdale Co.: 6 mi NE Conyers, *Pyron & McVaugh 1100* (GA, US)	16.2	6.8	1.8	0.86	3.5	5.0	36.1	58.1
FLORIDA: Washington Co.: Rock Hill, 4.5 mi SE Chipley, *Godfrey 63191* (FSU, KSC, NCU, USF)	13.2	6.6	1.5	0.92	3.0	3.9	30.4	54.1
ALABAMA: DeKalb Co.: Little River, 8 mi SE Fort Payne, *McDaniels 3930* (FSU, KSC)	12.5	6.1	1.7	0.59	4.2	4.1	36.3	56.9
ALABAMA: DeKalb Co.: Lookout Mtn., *Mohr 10* in 1892 (MO, NY, US)	14.7	6.3	1.8	0.63	3.5	3.9	38.0	59.2
LOUISIANA: Jeff Davis Par.: Welsh, *Palmer 8508* (MO, NY, US)	14.7	7.5	1.9	0.59	4.0	—	—	—
LOUISIANA: Vernon Par.: SW Slagle, *Thieret 25200* (KSC)	14.8	7.6	2.2	0.48	3.8	4.6	38.2	59.0
LOUISIANA: Calcasieu Par.: Lake Charles, *Mackenzie 480* (KSC, MO, NY, US)	14.4	7.5	1.9	0.51	4.4	4.4	33.7	56.9
LOUISIANA: Sabine Par.: 5 mi S Florien, *Thieret 20775* (DUKE, FSU, GA)	19.4	7.4	1.9	0.46	4.0	4.4	26.5	59.8
TEXAS: Newton Co.: 5 mi E Kirbyville, *Cory 49800* (GH, NY, SMU, TAES, US)	13.5	7.8	2.1	0.46	3.0	4.9	34.5	57.1
TEXAS: Brazoria Co.: Chocolat Bayou, *Lindheimer 86* in 1843 (GH, MO)	16.5	8.4	1.9	0.59	4.3	5.3	25.6	64.4
TEXAS: Austin Co.: *Tharp 44281* (KSC, MO, TEX)	15.1	8.4	2.3	0.34	4.0	5.1	28.0	55.8
TEXAS: Brazos Co.: Minter Springs, SW Wellborn, *Anderson 3173* (KSC)	17.2	9.0	2.3	0.57	4.9	5.3	29.2	61.4
TEXAS: Brazos Co.: Bryan, *Palmer 10735* (MO, US)	23.8	7.7	2.1	0.59	4.8	—	—	—
B. nudata ssp. *nudata*								
NORTH CAROLINA: Dare Co.: Roanoke Island, 2 mi S Manteo, *Godfrey & Fox 51041* (DUKE, FSU)	13.6	5.0	1.8	0.70	4.0	3.7	34.8	68.0
NORTH CAROLINA: Martin Co.: 4 mi SSE Smithwick, *Radford 41801* (NCU)	13.2	4.6	1.8	0.59	4.2	3.6	29.9	60.3
NORTH CAROLINA: Hyde Co.: 3.2 mi E Leechville, *Radford 42646* (NCU)	11.8	5.5	1.8	1.26	3.2	4.1	33.6	65.1
NORTH CAROLINA: Onslow Co.: 8 mi SW Jacksonville, *Godfrey 6450* (NCU, NY)	11.3	4.7	1.7	0.34	3.5	3.4	32.9	63.2

taxon and collection data	*bract number*	*involucral length, mm*	*involucral width, mm*	*receptacular cusp, mm*	*flower number*	*corolla length, mm*	*corolla lobe length—total length, %*	*stigmatic area—total style branch, %*
NORTH CAROLINA: Robeson Co.: 6 mi NE Lumberton, *Fox 5590* (FSU, GH)	13.0	4.7	1.8	0.70	4.3	3.6	27.5	59.7
NORTH CAROLINA: New Hanover Co.: Wilmington, *Smith 14367* (MO)	12.2	4.9	1.8	0.34	4.0	3.6	30.7	61.8
SOUTH CAROLINA: Horry Co.: Conway, *Grace* in 1940 (GH, MO)	10.3	5.7	1.7	0.42	3.3	3.9	29.8	61.5
SOUTH CAROLINA: Georgetown Co.: 5 mi S Georgetown, *Godfrey 8122* (DUKE, MO, NY, US)	15.7	5.8	2.1	0.17	4.7	3.9	32.6	60.0
	14.8	8.6	2.2	0.48	3.8	4.6	38.2	59.0
SOUTH CAROLINA: Orangeburg Co.: Eutawville, *Eggleston 5003* (GH, MO, NY, US)	11.6	5.8	1.8	1.25	3.8	4.0	29.8	63.0
SOUTH CAROLINA: Bamberg Co.: 2.5 mi S Denmark, *Ables 37586* (NCU)	10.6	5.1	1.8	0.21	3.6	3.6	29.4	63.2
GEORGIA: McIntosh Co.: 2 mi NE Ft. Barrington, *Bozeman & Radford 2318* (NCU)	12.8	5.2	1.7	0.79	3.0	3.6	34.9	64.2
FLORIDA: Duval Co.: Jacksonville, *Curtis 1356* (GA, GH, KANU, MO, NY, SMU, US)	15.5	5.9	1.8	0.55	3.3	4.2	36.5	65.8
FLORIDA: St. John's Co.: Orangedale, *Moldenke 164* (DUKE, MO, NY)	16.5	6.0	1.8	1.11	3.7	3.8	30.6	66.7
FLORIDA: Alachua Co.: 2.5 mi W Hawthorne, *Ward 3567* (DUKE, GA, NCU, SMU, USF)	15.2	5.6	1.8	0.81	4.0	3.8	37.0	64.9
GEORGIA: Lowndes Co.: Valdosta, *Huger* in 1913 (MO)	11.5	4.9	1.6	0.34	3.0	3.8	32.1	67.5
GEORGIA: Turner Co.: 6.5 mi S Arabi, *Anderson 3088* (KSC)	11.3	5.6	1.5	1.05	3.0	3.6	36.8	62.6
GEORGIA: Thomas Co.: 12 mi N Thomasville, *Godfrey 67434a* (FSU)	11.4	5.1	1.8	0.88	3.2	4.0	30.1	58.2
FLORIDA: Wakulla Co.: 3 mi S Newport, *Anderson 3070* (KSC)	12.6	4.8	1.6	0.70	3.3	4.0	36.2	61.1
GEORGIA: Grady Co.: 2 mi W Whigham, *Godfrey 63227* (FSU)	13.2	5.5	1.8	0.08	3.8	3.8	30.0	69.7
FLORIDA: Franklin Co.: Apalachicola, *Chapman 143b* (MO, NCU, NY, US)	12.8	4.9	1.8	0.80	3.5	3.6	34.7	60.8
FLORIDA: Washington Co.: Rock Hill, 4.5 mi SE Chipley, *Godfrey 63190* (FSU)	15.1	5.3	1.8	1.02	3.7	3.7	29.1	63.6
FLORIDA: Santa Rosa Co.: 4.5 mi E Gulf Breeze, *McDaniel 3864* (FSU)	15.4	6.1	1.7	0.67	3.0	3.9	26.9	62.0
ALABAMA: Baldwin Co.: Gateswood, *Tracy 8667* (MO, NY, US)	11.8	5.0	1.6	0.34	3.0	3.2	35.7	64.7
MISSISSIPPI: Jackson Co.: Ocean Springs, *Skehan 1345* (MO, NY, US)	14.0	5.0	1.9	1.30	4.0	3.6	28.7	61.0
MISSISSIPPI: Harrison Co.: Biloxi, *Tracy 4375* (KANU, MO, NY, SMU, US)	13.5	5.3	1.8	0.43	3.5	3.5	30.9	60.8
MISSISSIPPI: Forrest Co.: Hattiesburg, *Jones 11071* (KSC)	16.0	5.0	1.8	0.55	4.1	3.7	35.8	62.0
MISSISSIPPI: Pearl River Co.: Nicholson, *Kearney* in 1896 (NY)	14.4	5.6	1.6	0.96	2.6	3.6	34.9	61.1
LOUISIANA: St. Tammany Par.: Covington, *Hale s.n.* (KSC)	16.9	5.9	1.7	0.34	3.5	3.8	38.5	62.9

taxon and collection data	*bract number*	*involucral length, mm*	*involucral width, mm*	*receptacular cusp, mm*	*flower number*	*corolla length, mm*	*corolla lobe length—total length, %*	*stigmatic area—total style branch, %*
B. nudata ssp. *australis*								
FLORIDA: Pasco Co.: hiway 41, 2 mi N hiway 52, *Ray 9595* (FSU, USF)	14.8	6.8	2.2	0.85	4.0	4.4	33.9	62.8
FLORIDA: Pinellas Co.: Cross Bayou, *Barnhart 2774* (MO, NY)	13.0	6.6	2.4	0.81	5.2	5.0	36.4	63.0
FLORIDA: Pinellas Co.: 4 mi W St. Petersburg, *Deam 2841* (NY)	15.2	6.9	2.1	0.66	4.2	4.2	33.3	67.7
FLORIDA: Okeechobee Co?: Okeechobee region of Brevard Co. in 1903, *Fredholm 6155* (NY, US)	16.8	7.6	2.4	1.74	4.4	4.6	38.3	64.7
FLORIDA: Martin Co.: 6 mi W Stuart, *Godfrey 65642* (FSU)	17.0	6.8	2.3	0.79	4.0	4.4	32.9	62.1
FLORIDA: Martin Co.: 10 mi SE Sherman, *Kral 3949* (FSU, SMU)	16.3	6.9	2.3	0.72	5.0	4.5	36.1	69.1
FLORIDA: Lee Co.: 4 mi N Ft. Myers, *Godfrey 65376* (FSU)	19.2	7.2	2.4	1.16	4.2	4.8	32.4	64.5
FLORIDA: Lee Co.: Ft. Myers, *J. Standley 28* (GH, MO, NY, US)	14.0	6.0	2.3	1.10	5.3	5.0	31.0	67.0
FLORIDA: Lee Co.: Ft. Myers, *P. C. Standley 18886* (US)	14.8	6.8	2.2	0.38	3.6	4.4	36.1	76.0
FLORIDA: Collier Co.: west of hiway 29, Immokalee, *Anderson 3266* (KSC)	17.5	6.4	2.3	0.88	4.7	4.2	36.3	64.6
FLORIDA: Collier Co.: west of hiway 29, Immokalee, *Lakela 29408* (USF)	16.0	7.5	2.5	0.89	6.0	4.9	34.3	64.3
FLORIDA: Broward Co.: Fort Lauderdale, *Small & Carter 1026* (NY)	17.6	6.8	2.6	0.74	4.2	4.6	36.1	64.3
averages for *B. nuttallii*	15.1	7.4	1.9	0.56	3.8	4.6	32.7	59.0
averages for *B. nudata* ssp. *nudata*	13.3	5.3	1.8	0.67	3.6	3.7	32.5	63.0
averages for *B. Nudata* ssp. *australis*	16.0	6.9	2.3	0.89	4.3	4.6	34.8	65.8

TABLE 3. AVERAGED DATA FOR FLORAL FEATURES OF CERTAIN EUTHAMIA

Taxon and Collection	*Involucre*				*Ray flower*				*Disc flower*			
	bract number	*length, mm*	*width, mm*	*receptacular cusp, mm*	*flower number*	*corolla length, mm*	*limb length—total corolla length, %*	*limb width, mm*	*flower number*	*corolla length, mm*	*corolla lobe length—total length, %*	*stigmatic area—total style branch, %*
E. leptocephala												
Lonard 2008 (KSC)	20.6	5.4	2.1	1.03	10.2	3.5	50.0	0.21	3.6	3.8	34.0	52.2
Eggert in 1893 (KSC)	23.4	5.5	2.1	0.94	10.8	4.7	56.7	0.53	5.0	4.9	34.6	52.1
E. pulverulenta												
Lonard 2009 (KSC)	22.4	6.9	2.5	1.71	11.0	5.4	50.0	0.58	8.0	4.9	37.2	51.3
Cory 50667 (NY)	20.8	6.7	2.1	0.95	9.8	4.5	50.0	0.50	4.2	4.4	41.4	50.4
E. tennifolia												
Boettcher 399 (KSC)	16.0	4.7	1.9	1.28	7.8	6.3	56.0	0.94	4.6	5.6	32.4	53.8
Heller 732 (KSC)	18.0	4.5	1.9	0.89	8.8	4.8	54.0	0.57	5.8	4.7	38.7	54.2
E. gymnospermoides												
Anderson 2600 (KSC)	27.0	7.6	1.9	0.67	12.5	5.2	53.7	0.50	3.1	4.5	34.7	32.5
E. nuttallii												
Anderson 2153 (KSC)	26.6	5.0	2.2	0.79	24.2	2.1	47.7	0.30	6.6	4.9	39.7	34.3
E. occidentalis												
Anderson 1488 (KSC)	17.6	5.8	3.2	1.07	18.2	4.7	50.7	0.50	9.0	4.4	33.7	46.3

Disc flowers are similar to those of *Euthamia* with corolla lobes recurved and about one-third the total corolla length; whereas those of *Petradoria* are only slightly spread and about one-fifth the total corolla length.

Style branches are subulate and included in the corolla of *Bigelowia* and *Euthamia*; they are narrow and exserted in *Petradoria* and *Chrysothamnus* (Greene, 1895). The ratio of stigmatic line to total style branch length in *B. nuttallii* approximates that of the *Euthamia* taxa (*E. leptocephala*, *E. pulverulenta*, and *E. tenuifolia*) from the same geographic area; those Euthamias from the central United States have obviously different ratios (Table 3).

Mature achenes are turbinate and sparsely pubescent. Those of *B. nuttallii* are the largest, averaging 3.2 mm long. They average 1.5 mm long in *B. n.* subsp. *nudata*, and 1.8 mm in *B. n.* subsp. *australis*.

Bigelowia shows considerable variability when features of floral morphology are compared to geographical distribution. Geographical ranking of collections was done along the long axis of the taxon's range (as listed in Table 2), i.e., from east to west for *B. nuttallii*, northeast to southwest for *B. n. nudata*, and north to south for *B. n.* subsp. *australis*. Significance of correlation was determined by Pearson's rank correlation test. Those floral features that showed correlation with geographical distribution are listed in Table 4. Achene size in *B. nuttallii* may be correlated with geography also. Those from Georgia average 3.0 mm long, whereas those from Texas average 3.4 mm.

Subspecies of *B. nudata* show no overall clinal variation. Paradoxically, a strongly pronounced cline exists for *B. nuttallii*. This species has a markedly discontinuous distribution (Fig. 1). One might argue that the discontinuity is rather recent because of the presence of the cline, but why then would *B. nudata* with its continuous distribution not have such a pronounced cline?

TAXONOMY

BIGELOWIA DC., Prodromus 5:326. 1836 [*nom. cons.*, see Camp, W. H., H. W. Rickett, and C. A. Weatherby. 1947. International rules of botanical nomenclature. Brittonia 6:1-120].

Chondrophora Raf., New Fl. N. Am. 4:79. 1838 [not 1836, as frequently reported, cf. Barnhart, J. H. 1907. The dates of Rafinesque's New Flora and Flora Telluriana. Torreya 7:177-181].

Suffrutescent herbs with leafy rosettes from a small caudex and fibrous roots; stems 3-7 dm tall, glabrous, viscid when young; leaves entire, linear to oblanceolate, minutely glandular punctate; cauline leaves progressively reduced in size and frequency, upper ones linear, shorter than the internodes; heads several in open, corymbose inflorescences; involucres cylindric, 4.5-9 mm high, phyllaries spirally arranged in ± vertical ranks, lanceolate, weakly keeled; receptacle alveolate or with a central cusp; disc flowers 2-6, yellow; corollas glabrous with strongly recurved lobes; style branches subulate; achenes turbinate or somewhat cylindrical, sparsely pubescent; pappus bristles dull white, capillary.

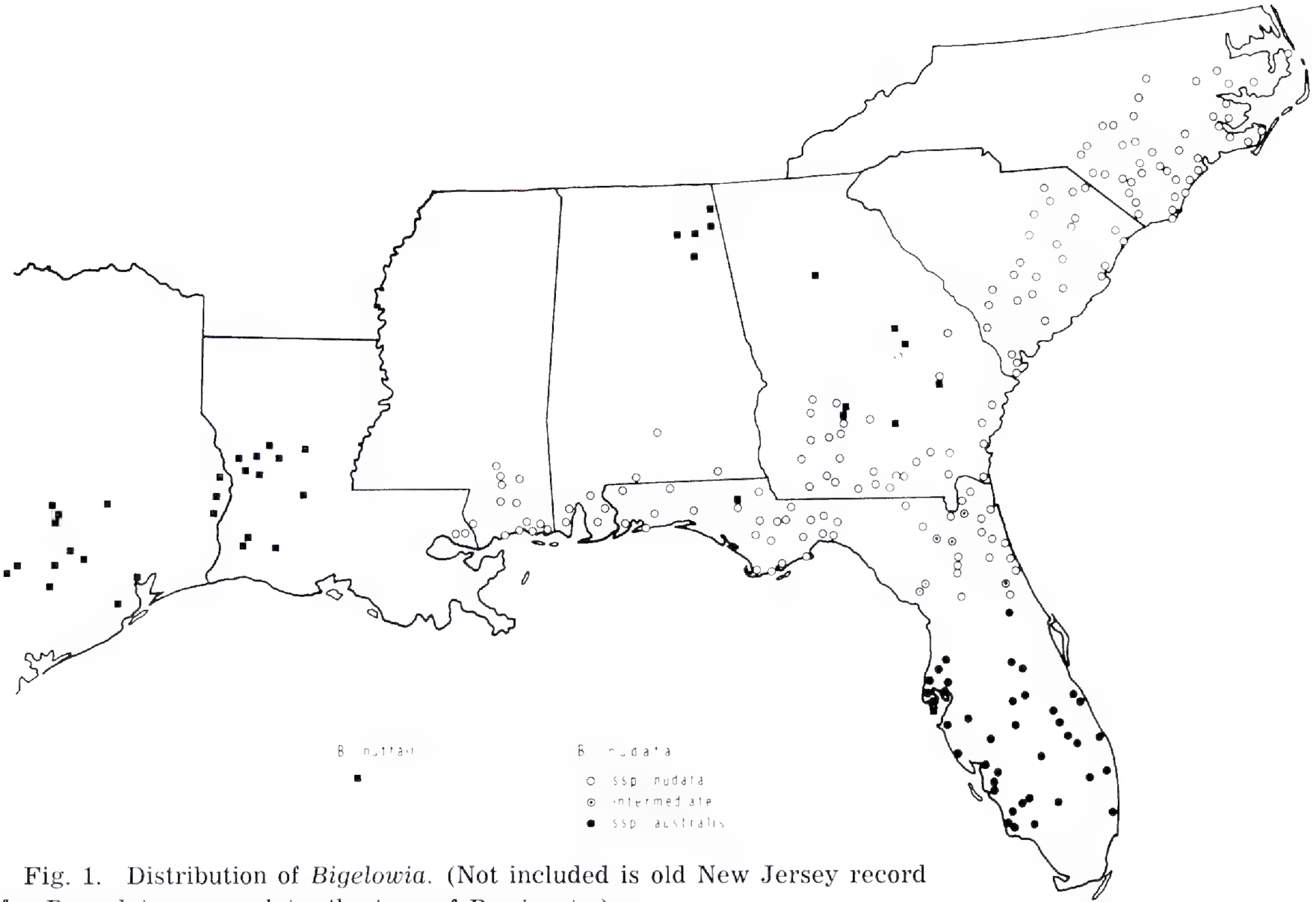

Fig. 1. Distribution of *Bigelowia*. (Not included is old New Jersey record for *B. nudata* ssp. *nudata*, the type of *B. virgata*.)

The genus consists of two species, *B. nudata* (type species) and *B. nuttallii,* from southeastern United States. It is closely allied to *Euthamia* in several aspects of morphology and appears to have similar ecological requirements. However, *Bigelowia* lacks ray flowers, hence the common name—rayless goldenrod. That distinction is not always a generic criterion; in fact, many species of Astereae have radiate and eradiate populations, e.g., *Chrysothamnus spathulatus* (Anderson, 1970). In addition, *Bigelowia* is distinct from *Euthamia* in habit; it has leafy basal rosettes and sometimes nearly scapose stems, whereas *Euthamia* has early-deciduous lower leaves and leafy stems.

A close relationship between *Bigelowia* and *Petradoria* was proposed by Greene (1895). He discounted the affinity of *Bigelowia* to *Euthamia* as suggested by Gray (1873) because "achenes in *Euthamia* are turbinate and silky." Greene apparently did not have adequate material, or he would have noted that achenes of *Bigelowia* are, in fact, turbinate and pubescent. Consequently, *Bigelowia* and *Petradoria* are dissimilar in their achenes as well as other morphological features (Anderson, 1963).

Affinity to *Chrysothamnus* (once considered part of *Bigelowia)* is not close.

Some observations have been made concerning phylogeny in *Bigelowia.* Harper (1911) suggested *B. nuttallii* might be a narrow-leaved extreme of *B. nudata,* developed in direct response to its rocky (drier) habitat. However, he preferred the alternative hypothesis—that *B. nudata* is the more recently derived and "being adapted to a widespread habitat became widely distributed."

Some features of the inflorescence of *B. nuttallii* such as larger, less numerous heads and larger flowers and seeds seem less specialized when compared with those of *B. nudata.* If *Bigelowia* is derived from *Euthamia*-stock, then rhizomaty in *B. nuttallii* might also be considered a primitive characteristic.

KEY TO THE TAXA

1. Plants definitely rhizomatous; all leaves narrowly linear, 1—2 mm wide (rarely more under cultivation) . . . . . 1. *B. nuttallii*

1. Plants cespitose or rarely weakly rhizomatous; lower leaves narrowly to broadly oblanceolate, spatulate or elliptic, 2—14 mm wide (*B. nudata*)

2. Basal leaves mostly less than 10 cm long, over 4 mm wide; flowers 3—4 mm long; heads 4.5—6.0 mm tall . . . 2a. *B. nudata* subsp. *nudata*

2. Basal leaves often over 10 cm long, less than 4 mm wide; flowers 4—5 mm long; heads 6.0—7.5 mm tall . . 2b. *B. nudata* subsp. *australis*

1. BIGELOWIA **nuttallii** L. C. Anderson, sp. nov. Perennis rhizomatosa (2.6) 3.5—5.0 (6.0) dm alta; folia basalia numerosa linearia (6) 8—12 (13) cm longa 1—2 mm lata, caulina 12—23 linearia infima 4.5—10.0 cm longa 1 mm lata; inflorescentia dense corymbosa plana; involucra 6.1—9.0 mm alta phyllariis 11—24; flores 3—5, corollae 3.9—5.3 mm longae lobis 1.2—1.6 mm;

linea stigmatica quam appendicula vix longior; achaenia 3.0—3.4 mm longa, pappus 4.0—4.4 mm longus.

Rhizomatous herbs with short narrow caudices; stems (2.6) 3.5—5.0 (6.0) dm tall; basal leaves numerous, linear (6) 8—12 (13) cm long, 1—2 mm wide; cauline leaves 12—23, linear, lowest ones 4.5—10.0 cm long, 1 mm wide; heads closely clustered in a flat-topped corymbose inflorescence; involucres 6.1—9.0 mm high, with 11—24 bracts; flowers 3—5, corollas 3.9—5.3 mm long, lobes 1.2—1.6 mm long; stigmatic line barely longer than style appendage; achenes 3.0—3.4 mm long; pappus 4.0—4.4 mm long (Fig. 1, squares).

Type: west bank, Ohoopee River, 3.5 mi W Reidsville, Tattnall Co., Georgia, at 100 ft. elevation, *Anderson 3455* (GA! KSC—holotype! NY! SMU! US!).

This is the plant which has long been known as *Bigelowia virgata* (Nutt.) DC. (or synonyms). The type locality of *Chrysocoma virgata* Nuttall however was New Jersey, far outside the range of the present species, but near the known modern limits of *B. nudata* subsp. *nudata*. A Nuttall collection (PH!; BM, photograph at KSC) labeled "*Chrysocoma virgata*, New Jersey" presumably is the type material. The PH sheet lacks basal parts; involucres average 5.3 mm long and corollas 3.5 mm long, the average involucral bract number is 15.2, all falling well in the range for *B. nudata* (see Table 2). Plants on the BM sheet (Fig. 2) have similar inflorescences and have basal parts of the plant intact; basal leaves are only 4 cm long and fully 11 mm wide.

Range: Locally established on sandstone or siltstone, usually confined to outcrops of Eocene to Pliocene strata from Georgia to eastern Texas. It is a characteristic species of the Altamaha Grit of Georgia, rock outcrops of the upper Oligocene studied extensively by Harper (1905, 1906b). Alabama populations are on sediments of the Carboniferous Period, and in Rockdale Co., Georgia, the plants occur on Lithonia Gneiss (Precambrian).

The species usually occurs on drier sites than *B. nudata*, but it grows along stream banks in northern Alabama well within reach of flood waters and also on rocks out in the streams (Harper, 1906a). Sept.—Oct.

Representative specimens: see Table 2; recently found in sandpine remnants in St. Petersburg, Pinellas Co., Fla., *Anderson 3464, 3468* (KSC), *Garrett s.n.* (FLAS).

2a. BIGELOWIA NUDATA (Michx.) DC. subsp. NUDATA, Prodromus 5: 329. 1836.

Chrysocoma nudata Michx., Fl. Bor. Am. 2: 101. 1803. "In humidis Carolinae," *André Michaux* (holotype P, photograph at KSC).—*Aster nudatus* (Michx.) Kuntze, Rev. Gen. 1: 318. 1891. — *Chondrophora nudata* (Michx.) Britton, Mem. Torrey Bot. Club 5: 317. 1894.

Bigelowia nudata var. *spathulaefolia* T. & G., Fl. N. Am. 2: 232. 1842. — *B. nudata* f. *spathulaefolia* (T. & G.) Gray, Proc. Am. Acad. Arts Sci. 8: 646. 1873.

Chrysocoma virgata Nutt., Gen. 2: 137. 1818. "On borders of swamps in

Fig. 2. Type material of *Chrysocoma virgata* Nuttall (BM, photograph at KSC).

New Jersey, near the sea-coast," *T. Nuttall* (apparent type material PH!, BM, photograph at KSC; see discussion following citation of type of 1. *Bigelowia nuttallii*). — *Bigelowia nudata* var. *virgata* (Nutt.) T. & G., Fl. N. Am. 2: 232. 1842. — *B. nudata* f. *virgata* (Nutt.) Gray, Proc. Am. Acad. Arts

Sci. 8: 646. 1873. — *Chondrophora nudata* var. *virgata* (Nutt.) Britton, Mem. Torrey Bot. Club 5: 317. 1894. — *Chondrophora virgata* (Nutt.) Greene, Erythea 3: 91. 1895. (All these names have been mistakenly applied to the preceding species, *B. nuttallii* L. C. Anderson.)

Cespitose herbs with short, thick caudices; stems (3.7) 5—7 (8) dm tall, often nearly scapose with reduced leaves; basal leaves oblanceolate, gradually attenuated into the short petiole, (4) 6.5—10.0 (14) cm long, (4) 6—9 (14) mm wide; cauline leaves (6) 10—13 (15), oblanceolate or spatulate, lowest ones (3) 4.5—6.0 (9) cm long, (2.5) 3.5—7.0 (12) mm wide; heads loosely clustered in rounded or flat-topped corymbose inflorescences; involucres 4.5—6.0 mm high with 10—17 bracts; flowers 2—5, 3.0—4.2 mm long, lobes 1.0—1.5 mm long; stigmatic lines noticeably longer than stigmatic appendages; achenes 1.2—1.6 mm long; pappus 2.8 mm long (Fig. 1, open circles).

Range: Moist sandy loams of savannahs, pine barrens, and margins of swamps in the coastal plain from North Carolina to Florida and westward to eastern Louisiana. Aug.-Nov.

Representative specimens: see Table 2.

2b. BIGELOWIA NUDATA (Michx.) DC. subsp. **australis** L. C. Anderson, subsp. nov.

Subrhizomatosa, caudices angusti; folia basalia saepe ultra 10 cm longa, infra 4 mm lata; corollae 4—5 mm longae; capitula 6.0—7.5 mm alta.

Somewhat rhizomatous, caudices narrow, 2.5—3.5 cm long; stems (2.2) 4—5 (8.6) dm tall; basal leaves linear oblanceolate to narrowly spatulate, (6) 9—14 (22) cm long, 2.0—4.5 mm wide; cauline leaves (5) 9—12 (19), lowest ones linear spatulate, (4.5) 7—10 (17) cm long, 1.5—3.0 mm wide; heads congested into somewhat rounded or flat-topped corymbose inflorescences; involucres 6.0—7.6 mm high, with 13—20 bracts; flowers 3—6 per head; corollas 4—5 mm long, lobes 1.4—1.8 mm long; stigmatic lines two-thirds the total style branch length; achenes 1.6—2.0 mm long; pappus 3.0—3.3 mm long (Fig. 1, closed circles).

Type: In pinelands, vicinity of Ft. Myers, Lee Co., Florida, 20 March 1916, *Jeanette P. Standley 28* (GH! MO! NY-holotype! US!).

Range: Rich sandy soil of wet prairies and open pinelands of peninsular Florida; its range rapidly being reduced by "advances of civilization" (Lakela, personal communication). This taxon occurs in areas usually free of killing frosts; consequently, blooming frequently occurs in the spring as well as during the autumn and winter months. Oct.-May.

Representative specimens: see Table 2.

Intergradation between the subspecies of *B. nudata* is limited (encircled dots, Fig. 1), possibly due to phenological variance. Some vegetative collections from northern Florida appear intermediate: Bradford Co.: near U.S. 301, *Radford 8248* (NCU); Flagler Co.: 5 mi E Seville, *Smith & Myint 451* (FSU); Union Co.: Danville, *Murrill 773* (US). A collection in flower, *Nash 2597* (GH, MO, NY, US) from Baldwin, Duval Co., shows intermediacy in several features. Involucral bract number and flower number suggest *B. n.*

TABLE 4. RANK CORRELATION OF SELECTED FLORAL FEATURES WITH GEOGRAPHIC DISTRIBUTION OF BIGELOWIA TAXA.

	B. nuttallii (D.F.=15)		*B. n. nudata* (D.F.=27)		*B. n. australis* (D.F.=11)	
Bract number						
Correlation coefficient	.776		.340		.552	
Significance		1%		—		10%
Involucral length						
Correlation coefficient	.727		.239		-.279	
Significance		1%		—		—
Involucral width						
Correlation coefficient	.874		-.257		.455	
Significance		1%		—		—
Flower number						
Correlation coefficient	.648		-.313		.185	
Significance		1%		—		—
Flower length						
Correlation coefficient	.521		-.102		.154	
Significance		5%		—		—

nudata, and length of involucre and flowers are more like *B. n. australis;* whereas the stigmatic line ratio is like that found in *B. nuttallii.*

The morphology of *B. n. australis* is intermediate to that of *B. n. nudata* and *B. nuttallii* in many respects (see Table 2). The phenotypic closeness to *B. nuttallii* may reflect derivation, in part, from ancient *nuttallii* stock; however, the features of largeness in *B. n. australis* morphology may be due simply to excellent adaptation of this taxon to the longer growing season.

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FLORAL ANATOMY OF CHRYSOTHAMNUS (ASTEREAE, COMPOSITAE)[1]

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INTRODUCTION

Details of floral anatomy are presented as part of a series of anatomic studies on *Chrysothamnus*. Although morphological variation in these shrubs of western North America is great enough to warrant the taxonomic designation "difficult genus," relatively little has been written on the anatomy of *Chrysothamnus*, particularly its floral anatomy.

Snow (1945) reported details of floral anatomy for one population of *C. nauseosus*. Recently, some features of floral anatomy of *C. vaseyi* (Anderson, 1963) and *C. bolanderi* (Anderson and Reveal, 1966) were considered in relation to other problems. A paper on embryology (Anderson) is in press.

Species studied are arranged phylogenetically and by sections:
Nauseosi: *C. parryi* (Gray) Greene, *C. nauseosus* (Pallas) Britt.;
Chrysothamnus (*Typici*): *C. linifolius* Greene, *C. spathulatus* L. C. Anders., *C. albidus* (Jones) Greene, *C. greenei* (Gray) Greene, *C. viscidiflorus* (Hook.) Nutt., *C. humilis* Greene;
Pulchelli: *C. vaseyi* (Gray) Greene, *C. molestus* (Blake) L. C. Anders., *C. depressus* Nutt., *C. pulchellus* (Gray) Greene;
Punctati: *C. teretifolius* (Dur. & Hilg.) Hall, *C. paniculatus* (Gray) Hall. This presentation differs from that of Hall and Clements (1923). *Chrysothamnus gramineus* has been transferred to *Petradoria* (Anderson, 1963) and *C. pyramidatus*, to *Haplopappus* (Blake, 1926). *Chrysothamnus vaseyi* is placed in a different section. New species include *C. molestus* and *C. spathulatus*; *C. linifolius* and *C. humilis* again are recognized as distinct species. Two new combinations are made: C. PARRYI (GRAY) GREENE SSP. **affinis** (A. NELS.) L. C. ANDERS., COMB. NOV. [based on *C. affinis* Nels., Bot. Gaz. 28:374, 1899] and C. NAUSEOSUS (PALLAS) BRITT. SSP. **psilocarpus** (BLAKE) L. C. ANDERS., COMB. NOV. [based on *C. nauseosus* var. *psilocarpus* Blake, J. Wash. Acad. Sci. 27: 376, 1937]. Undescribed taxa are entered in tables parenthetically under the taxon they most closely resemble. Species of two sections of *Haplopappus (Macronema* and *Ericameria)* are included for comparison. Relevance of the two sections has been discussed previously (Anderson, 1966; Anderson and Reveal, 1966).

METHODS AND MATERIALS

Fresh materials were generally fixed in formalin-proprionic-alcohol; those used in developmental studies, in Craf V (Sass, 1958). Dried heads were

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treated in 2.5% NaOH to revive cell shape and size, then processed as the fixed materials. Infiltration, embedding, and sectioning in paraplast followed dehydration through a graded tertiary butyl alcohol series.

Heads with considerable sclerenchyma were softened in hydrofluoric acid before being dehydrated. That was particularly useful with more mature heads; otherwise, dehydration and infiltration frequently caused the achenes to dehisce.

Sections were normally made at 12$_{\mu}$ but were cut thinner for developmental series. Staining with safranin was first mordanted with tannic acid followed by ferric chloride (Sass, 1958). Counterstains were either fast green FCF or fast green followed by orange G. Whole flowers were cleared in 2.5% NaOH, dehydrated in a graded ethyl alcohol series, stained in safranin, then transferred to xylene and mounted in permount.

Flowering heads of over 170 populations were used in general studies. Heads from some 50 additional populations were used to confirm distribution of specific features. At least two populations were studied intensively for each taxon. Voucher specimens are in the Kansas State University herbarium unless otherwise indicated; personal collections are indicated by *A*. Utah State University and Rancho Santa Ana Botanic Garden provided garden space, which was deeply appreciated. Mr. Kent Fish prepared many of the slides.

DEVELOPMENTAL ANATOMY

Snow's study (1945) on a population referrable to *C. nauseosus* ssp. *albicaulis* included details of ontogenetic development of floral parts. Her observations are largely applicable to the entire genus; therefore, only features that are new or different are discussd in detail here.

In most species of *Chrysothamnus*, floral organs are initiated in the following sequence: corolla, stamens, pappus, and pistil as figured by Snow (1945). In *C. pulchellus*, the floral primordia differentiate through the sequence of corolla, pappus, stamens, and pistil (Figs. 1-4). The developing primordial lobes of the pappus attain considerable size before the stamens are initiated (Fig. 2).

Precocious development of the pappus is reflected in the mature flower, where the corolla at anthesis is overtopped and often hidden by the copious pappus bristles. That condition may result partially from a slower growth rate in the corolla of that species than in other taxa in the genus. In *C. pulchellus*, the involucre is half its mature length when flower primordia develop, as in Fig. 1. The involucre is nearly full size at time of meiosis. That differential growth rate is less noticeable in *C. depressus*, whereas in other species the developmental rates of involucre and flowers more closely parallel. In fact, in several subspecies of *C. viscidiflorus* the involucral bracts barely surpass flower length at meiosis.

Other species with the *C. pulchellus* pattern of floral ontogeny are *C. depressus*, *C. molestus*, and *C. vaseyi* (all of section *Pulchelli*). In them, pappus

development commences just before the stamens, and the pappus does not overtop the corolla in mature flowers.

VASCULAR ANATOMY

Involucre

In most taxa of *C. parryi*, three vascular traces enter each bract (Fig. 5); however, *C. p.* ssp. *parryi*, *C. p.* ssp. *nevadensis*, and *C. p.* ssp. *asper* frequently have five bundles in the larger (outer) bracts. Lateral traces usually extend half of the length of the phyllaries in *C. parryi*; in all other species of the genus the lateral traces terminate at the base of each phyllary. All bracts of *C. nauseosus* ssp. *albicaulis* and *C. n.* ssp. *graveolens* have three traces; other subspecies have three in the outer bracts and one trace in each of the two or three innermost bracts of the head (3/1 pattern).

In section *Chrysothamnus*, *C. linifolius*, *C. albidus*, and *C. greenei* have primarily the three trace per bract pattern, whereas *C. spathulatus* has the 3/1 pattern. Heads of *C. viscidiflorus* vary considerably with *C. v.* ssp. *viscidiflorus*, *C. v.* ssp. *lanceolatus*, and *C. v.* ssp. *planifolius* principally having the 3 pattern and other subspecies having the 3/1 pattern. However, some populations of *C. v.* ssp. *stenophyllus* have only one trace per bract.

In section *Pulchelli*, *C. vaseyi* ranges from the 3 to the 3/1 pattern; *C. molestus* has only the 3/1 pattern, whereas *C. depressus* has the 3/1 or 1 pattern. Possible trends for both expansion and reduction of vascular supply are present in *C. pulchellus* where several populations have the 3 pattern (Fig. 6), but a few have five traces in the outer bracts. Others have 3/1 and one population has the 1 pattern.

Both *C. paniculatus* (Fig. 7) and *C. teretifolius* of section *Punctati* have the 3/1 pattern.

Haplopappus macronema, *H. bloomeri*, and *H. ophitidus* of section *Macronema* have three traces per bract; the lateral traces extend up into the bracts. In *Ericameria*, bracts of *H. propinquus* have the 3 pattern, whereas *H. sonoriensis* and *H. trianthus* have the 3/1 pattern, and *H. pyramidatus* has one trace per bract.

Flower

Venation in flowers of *Chrysothamnus* is relatively advanced for the Compositae. The flower vasculature is derived from the stem as a single bundle. That bundle divides in the base of the achene to first supply the dorsal ovarian bundles, then the laterals, and finally the ventral ovarian bundles. Ovarian bundles range from ten to as few as five. The single ovular trace is a continuation of the vascular supply from the receptacle. In each instance the ovule's vascular supply differed somewhat from Snow's figures (1945). The disc flowers generally have five veins in the corolla, two in the style, and one in each stamen.

The transition from ovarian traces to those of the corolla, stamens, and style can be categorized in five major patterns (Fig. 8, a-e). Observed fre-

quencies of these basic patterns are listed in Table 1. Vascular pattern A has 10 traces in the achene. At the top of the achene the ventral bundle (nearest the axis of the capitulum) and one dorsally positioned each divide to supply a vascular bundle to the style. Those same bundles accompanied by three other ovarian bundles produce the staminal traces before continuing on into the corolla base. The five additional ovarian bundles end blindly at the top of the achene. In most taxa the stylar trace from the ventral ovarian bundle (no. 1 in Fig. 8, a-e) diverges before the one from the dorsal ovarian bundle; however in *C. linifolius* the ventral (adaxial) stylar trace diverges much later. Pattern B also has 10 traces in the achene but differs in that a dorsal ovarian vein terminates as a stylar bundle and does not enter the corolla.

Patterns C and D have a reduction in ovarian trace number with nine to six bundles present in the achene (arbitrarily illustrated as seven in Fig. 8, c-d). In pattern C the dorsal style bundle is associated with a corolla bundle; in D it is not. There is no set pattern regarding which bundles will enter the corolla and which will end blindly at the top of the achene. In flowers with only one extra bundle in the achene, it is usually one on either side of the ventral bundle that ends blindly.

Pattern E, the reduced type, is the one described by Snow (1945). There are only five ovarian bundles so none ends blindly at the top of the achene (see Fig. 24). Bundle no. 3 or 4 may supply the dorsal stylar bundle. The 1-3 pattern of stylar vasculature is more frequent, but both patterns may exist in the same head. In addition, two basic patterns, such as C and E or C and D, can be in different flowers of the same head.

Hall and Clements (1923) state: "Two very unlike types of achenes are encountered in the genus." One is "obscurely 5-angled or terete and 5-nerved . . . the other form which occurs only in *C. vaseyi* and *C. gramineus* . . . is distinctly 10-striate." Actually, there are 5-10 vascular bundles in *C. vaseyi* achenes (Table 1) and only 5 in *C. gramineus* (= *Petradoria discoidea*; Anderson, 1963). Several of the other *Chrysothamnus* species have more than 5 bundles.

Vascular patterns in some *Haplopappus* species are also listed in Table 1. A greatly reduced pattern characterizes *H. pyramidatus*. Only two ovarian bundles are present. The ventral bundle supplies three traces to the corolla and its associated stamens and one to the style, and the dorsal bundle supplies the other two to the corolla and stamens and one to the style.

Several interesting features are found in the "transition region" at the top of the achene where the ovarian bundles supply the vasculature to the corolla, androecium, and style. In nearly all populations the individual ovarian bundles remain distinct and either end blindly or pass into the corolla or style. However, in a few populations representing all species, the ovarian traces fuse at the top of the achene to form a ring of vascular tissue. The coalescence of vascular traces, when present, usually occurs before departure of style bundles; but in *C. pulchellus* the ring is formed after the stylar

and staminal traces have departed. Vascular ringing is never so developed that it precludes identification of the basic pattern. In some cases the vascular ring is formed only by the phloem with the xylem strands remaining distinct.

Another departure from the standard vascular patterns is the presence of two additional stylar traces (Fig. 9). They are supplied by lateral ovarian bundles at right angles to the usual dorsal-ventral style traces. The greatest development consists of four traces present up to the style branches with just a single trace entering each branch. Two samples of *C. parryi* ssp. *parryi* and one each of *C. p.* ssp. affin. *attenuatus* (*A 1782*) and *C. linifolius* have this extensive stylar vasculature. Additional style traces, when present, usually terminate at the base of the style or even at the top of the ovary. That condition was found in four subspecies of *C. parryi* and in one sample of each of the following: *C. nauseosus* ssp. *albicaulis*, *C. depressus*, *H. macronema*, and *H. bloomeri*. Additional style traces ending in the ovary and represented only by phloem were found in one sample of each of the following: *C. parryi* ssp. *asper*, *C. p.* ssp. *attenuatus*, *C. nauseosus* ssp. *bernardinus*, *C. viscidiflorus* ssp. *lanceolatus*, and *C. v.* ssp. *viscidiflorus*.

Pappus in *Chrysothamnus* does not contain vasculature. Traces diverged toward the base of pappus bristles were observed only in one population of *C. parryi* ssp. *vulcanicus* (Fig. 32).

Ray flowers, long considered foreign to *Chrysothamnus*, are present only in two populations of *C. spathulatus* (Fig. 11). They are found in nearly every head on plants from canyons of Guadalupe Mountain, Culberson County, Texas (the southern-most point of the species). Plants from the Jicarilla Mountains in Lincoln County, New Mexico, represent the northern-most population of the species; those only occasionally have ray flowers. In both cases rays are no larger than the disc flowers and have a long tube and narrow, often involute limb. The commonest vasculature for these inconspicuous flowers is six ovarian bundles and four in the corolla with two in the style (diagrammatically represented in Fig. 8, f). In one case the adaxial vein of the corolla tube divided at the sinus to form the two laterals of the five-veined limb. Four veins were found in the tube (Fig. 11) and limb of all other samples. The androecium was lacking in all ray flowers.

HISTOLOGY

Involucre

Phyllaries are not treated in great detail because they are similar to the leaves and share many features with the vegetative anatomy of the plants (subject of a future paper). The most notable difference anatomically is the extensive development of sclerenchyma in the phyllaries.

The involucral bracts were studied at three levels: 1.) At a short distance below the tip of the bract, the tissue composition near the midrib usually has one or two rows of parenchyma adjacent to the adaxial epidermis, followed by two or three rows of sclerenchyma, and two or three rows of palisade

parenchyma next to the abaxial epidermis. This palisade is responsible for the "sub-apical green spot" of the bract (outermost bract in Fig. 6). Inner bracts of the involucre lack this chlorenchyma. Some samples lack rows of sclerenchyma but have islands of a few fibers scattered abaxially in the bract tip. 2.) Midway down the length of the bract, tissues contain from three to six rows of sclerenchyma next to the outer epidermis. 3.) The bract varies most near its base. In *C. parryi* the "mesophyll" is 10-18 cells thick and entirely parenchymatous (Fig. 5). At the other extreme the bract is thinner and less leaf-like, having three rows of adaxial parenchyma and eight rows of abaxial sclerenchyma; this pattern is found in *C. paniculatus*.

Percentage of sclerenchyma to total mesophyll (averaged from the three levels) is from 40-60% for most taxa. The least sclerenchyma is found in *C. parryi* ssp. *parryi* (16%); most subspecies of *C. parryi* have 25-45% sclerenchyma. Greatest development of sclerenchyma is in section *Punctati*. *Chrysothamnus paniculatus* has 68% and *C. teretifolius*, 74%; in the latter the large-celled adaxial parenchyma have thick walls from secondary sclerosis.

Large secretory canals are usually found abaxially in the midrib of each bract (Figs. 5-7). The lateral bract bundles also have secretory canals associated with them in the following: *C. parryi* ssp. *parryi*, *C. p.* ssp. *asper*, *C. p.* ssp. *nevadensis*, *C. p.* ssp. *vulcanicus*, and occasionally in *C. linifolius*. A reduction of secretory apparatus is found in *C. paniculatus*, *C. teretifolius*, and a few subspecies of *C. nauseosus* and *C. viscidiflorus*. In the first, the tips of the outer bracts lack secretory canals; in the remaining taxa mentioned the canals are absent from the basal portions of the inner bracts.

Trichomes are abundant on developing bracts (Figs. 1-2), and nearly all taxa have some at maturity. Glandular trichomes are present on most taxa; they are usually on the adaxial surface of the bract, but in section *Punctati* they are abaxially located (Fig. 7). Section *Pulchelli* is characterized by having short, stiff nonglandular trichomes on the abaxial phyllary epidermis. Those hairs are frequent on *C. depressus*, less so on *C. molestus*, and much rarer on the remaining species of the section. All but *C. depressus* have adaxially located glandular hairs as well.

Members of section *Nauseosi* have long, uniseriate, nonglandular trichomes on their stems. Phyllaries may have either glandular or nonglandular hairs or both. Most taxa of *C. parryi* have adaxial glandular hairs and abaxial nonglandular hairs; *C. p.* ssp. *latior*, however, lacks the latter. In *C. nauseosus* the "gray forms" (*C. n.* ssp. *albicaulis*, *C. n.* ssp. *hololeucus*, etc.) have nonglandular trichomes exclusively, whereas the "green forms" (*C. n.* ssp. *consimilis*, *C. n.* ssp. *graveolens*, etc.) have only glandular trichomes.

Flower

Trichomes. The taxa vary as to kind, size, and quantity of trichomes they bear; vesture is tabulated in Table 1 and illustrated in Figs. 13-23. Explanation of symbols in Table 1 is: g, glandular; n, nonglandular; + +, abundant; +, frequent; —, rare.

Trichomes may be found on the achene, on the corolla tube, and on the tips

of corolla lobes. The commonest trichome on the achene is the "twin-hair" (Zwillingshaare). The hairs are four-celled, biseriate, and nonglandular (Figs. 13-14); they have thick walls that are anisotropic under polarized light. The twin-hairs range from less than 100 to over 700 long and are abundant when they are the only type found on the achene. They are much less frequent and somewhat caducous in *C. spathulatus*.

Truly glabrous achenes, i.e., ontogenetically so, are found only in certain taxa of *C. nauseosus* (see Table 1). One taxon not listed in the table, *C. n.* var. *petrophilus*, also has glabrous achenes—the only feature that separates it from *C. n.* ssp. *consimilis*. Achenes of section *Pulchelli* are often referred to as glabrous. However, excluding *C. pulchellus*, all species have glandular trichomes scattered over the distal half of the achene (Figs. 15-16); in addition, a few short twin-hairs usually are present. In *C. pulchellus*, the developing ovaries often have nonglandular trichomes. Mature achenes may be glabrous (Fig. 6), or a few twin-hairs may persist. *Haplopappus bloomeri* and *H. ophitidus* also have nearly glabrous achenes.

An intermediate pattern is found in *C. albidus* and *C. humilis*. Both have abundant twin-hair groups on the achenes, which mask the glandular trichomes also present (Fig. 31).

Trichome occurrence on the corolla largely follows sectional lines in *Chrysothamnus*. Hairs on the corolla tube are relatively abundant in section *Nauseosi*. The hairs are elongate biseriates, often termed villi (Figs. 17-19); both nonglandular and glandular forms may be present. In *C. parryi* the distinction between the two categories is nearly lacking due to the narrow heads on the glandular trichomes (Fig. 18). Occasionally, a few anisotropic uniseriate hairs are present on the corolla tube as in *C. nauseosus* ssp. affin. *turbinatus* (*A 1771*).

Hairs on the corolla tube are infrequent in sections *Chrysothamnus* and *Pulchelli*, being found only in *C. humilis* (Fig. 21) and some subspecies of *C. viscidiflorus* and in *C. molestus*, respectively. In section *Punctati* glandular hairs are common on the corolla tube (Fig. 22); they are shorter and more clavate than the glandular hairs in the *Nauseosi*.

The corolla lobes in section *Nauseosi* often bear trichomes (Table 1). Hall and Clements (1923) listed this feature for only three taxa. The usual form is a long uniseriate hair that is anisotropic (Fig. 23). Length determinations are hampered by hairs breaking when handled; many are over a millimeter long. Corolla lobes are glabrous in *C. nauseosus* ssp. *albicaulis* over most of its range; however, two widely separated populations of this taxon have villous corolla lobes. They are from Kane County, Utah (*A 1725*), and Walla Walla County, Washington *(E. F. Anderson 2071)*. Biseriate hairs on corolla lobes, when present, are usually glandular and isotropic, but on *C. n.* ssp. affin. *turbinatus* (*A 1778*) biseriate nonglandular hairs occur as well as uniseriate ones. The biseriates are similar to the twin-hairs of the achene except they are shorter and isotropic. Glandular trichomes are particularly abundant on corolla lobes of *H. pyramidatus* (Table 1).

All species have epidermal pappilae, especially at the tips of corolla lobes. In some, such as *C. parryi* ssp. *parryi* and *C. nauseosus* ssp. *bernardinus*, the pappilae extend 90$_\mu$ from the epidermis. Many species have lignified epidermal cells at corolla tips that are anisotropic.

Secretory apparatus. The flowers may contain secretory canals associated with vascular tissue in four areas: the ovary wall of the achene, the corolla tube from the point of staminal departure to the tips of their lobes, the upper part of the style and its branches, and in the anthers. Secretory canals in the anthers are found only in some populations of *C. parryi* ssp. *parryi* (Fig. 12). Abundance of secretory canals in the three other regions of the flower is listed in Table 1. Determination of frequency (++, abundant; +, frequent; —, rare; 0, absent) was made at seven zones (Fig. 24); zones I and II are from the achene, III-V from the corolla, and VI and VII from the style.

Members of *Nauseosi* have the greatest development of secretory canals, whereas canals are entirely absent in flowers of *C. albidus* and *C. paniculatus*. Distribution of canals follows section lines fairly well. *Chrysothamnus* and *Pulchelli* have no canals in the style (zones VI and VII, Fig. 24). Nonetheless, *Punctati*, a rather well-defined section from external morphology, has discordant species as far as secretory apparatus is concerned.

Tissue composition. Most taxa from all sections have well developed sclereids representing the seed coat (ovule wall) in the ovary. The sclereids have thickened radial and especially outer tangential walls (Figs. 25-28). In sections *Chrysothamnus* and *Pulchelli* there is a tendency for greater sclerification of the ovary wall as seen in clusters of thick-walled cells in achenes of *C. spathulatus* (Fig. 27). The entire ovary wall is sclerosed at maturity in *C. pulchellus* (Fig. 28); achenes of that species also have the thickest ovary walls in the genus.

Ground tissue of the corolla is parenchymatous. In the corolla lobes the parenchyma is frequently disrupted near the veins by lacunae. Tissue thickness was measured at three points (Fig. 24, levels A-C) and recorded in Table 1. Level A is at the corolla base just at the top of the nectaries, level B is just above the point of staminal filament departure, and C is just below the sinuses of the corolla lobes. Section *Pulchelli* has the thickest corollas, followed by *Chrysothamnus*.

Staminal filaments often have protoxylem lacunae. Staminal endothecium is as follows. In the anthers the outer tangential and radial walls of the hypodermis have the characteristic fibrous thickenings. On the abaxial side of the connective below the anther and in the sterile appendage above the anther, all walls of the hypodermis and the inner walls of the epidermis are differentiated as endothecium. Both surfaces of the anther appendage have endothecium in *C. humilis*.

Endothecial thickenings in the anther wall follow the patterns described by Dormer (1962). All three categories, i.e., polarized, radial, and transitional tissue, are represented. The polarized tissue has two to three prominent vertical bars on the faces of each cell wall. Although polarized fibrous thicken-

ings are predominant in the family as a whole, radial tissue with horizontal bars is the most abundant in *Chrysothamnus*, and that is the basic type in the Astereae (Dormer, 1962).

Cells of the corolla base, and particularly the style base, develop heavy secondary walls as the flowers pass anthesis (Fig. 10). That tendency is most pronounced in *Pulchelli* and *Chrysothamnus*.

A continuous ring of tissue around the base of the style rises into five prominent nectaries (Fig. 29). They are alternate to the stamen positions and vary considerably in size and shape. Size is perhaps best measured in relation to flower size; that was done by measuring style length up to the base of the style branches. Longest nectaries, by that relationship, are in *C. albidus*; they are 4.2% of the unbranched style length. Other taxa with large nectaries (3.8%) are *C. paniculatus* (Fig. 30) and *C. nauseosus* ssp. *consimilis*. Most nectaries range from 1.5 to 2.5% of the unbranched style length. Very small nectaries in the form of low humps (less than 1.0% the style length) are found in *C. depressus, C. molestus, C. humilis* (Fig. 31) and some subspecies of *C. viscidiflorus*. Most nectaries are partially fused with the style base as in *C. parryi* (Fig. 32).

ENVIRONMENTAL EFFECTS ON ANATOMY

Features studied in original collections were compared with those produced in plants in experimental gardens at Logan, Utah, and Claremont, California. Relative genetic uniformity was obtained by transplants or through progeny. Seedlings were considered genetically close to original collections as the taxa are basically inbreeding (Anderson, 1966).

Table 2 includes topographic, climatological, and edaphic data for the gardens; Table 3, features of the original localities. Climatological data for the gardens were obtained at the garden sites and reflect climates for one year prior to harvest; plants in the Claremont garden were irrigated only as needed to insure establishment (Claremont precipitation averages 19-20'' annually). Climatological data for original collection sites are based on 20-year averages; when recording stations were farther than 10 miles from the collection site, data are considered estimates (prefix E in Table 3) for the collection sites.

Environmental extremes between the two gardens were probably sufficient to produce the main amplitude of anatomic variation possible for each collection's genotype. Differences in temperature are particularly noteworthy: mean monthly minimums at Claremont were never below 40° F.; whereas mean monthly maximums at Logan were near or below freezing for three months.

Floral features are included in Table 4 (same format at Table 1) only for collections represented in both gardens; however, additional taxa were used in garden studies. Most propagations survived and flowered, but plants of *C. paniculatus* died in the Logan garden during the first growing season. Vigor in surviving plants was usually reduced when the gardens differed con-

siderably from the natural habitat. External morphology varied much more than did internal anatomy. The most sensitive floral feature is flower number in *C. parryi*. In the Claremont garden, different plants of *C. parryi* ssp. *parryi* averaged from five to nine flowers per head.

Only minor fluctuations occurred in floral anatomy in the gardens, but trichomes of *C. vaseyi* achenes were an exception. The achenes of *C. depressus*, *C. molestus*, and *C. vaseyi* are frequently described as glabrous; however, they all have glandular and nonglandular trichomes at the distal end of the achene (Table 1). The glandular hairs are readily apparent under a hand lens; the less frequent nonglandular hairs were first observed in sectioned materials under the microscope. The nonglandular trichomes (twin-hairs) became more abundant in the garden propagations of *C. vaseyi*. In the Logan garden, they equalled the glandular hairs in frequency and completely covered the achenes in the Claremont garden.

ANATOMY OF HYBRIDS

Hybridization in *Chrysothamnus* is infrequent. In the absence of gross chromosomal irregularities in meiosis in presumed hybrids (Anderson, 1966), anatomic comparisons are valuable in determining hybridity. Such comparisons have been made for *C. bolanderi* (Anderson and Reveal, 1966).

Putative hybrids between *C. parryi* ssp. *parryi* and *C. nauseosus* ssp. *nauseosus* were recorded earlier (Anderson, 1966); features of their floral anatomy are listed in Table 5 (format that of Table 1). In addition, glandular trichomes on the corolla lobes were most abundant in *C. parryi* ssp. *parryi*, intermediate in frequency in the hybrids, and least abundant in *C. nauseosus* ssp. *nauseosus*. The hybrids were also intermediate in nectary size; *C. nauseosus* had the largest, and *C. parryi* the smallest.

Involucral bract structure and alignment suggest the type collection of *C. nauseosus* ssp. *viscosus* (*Munz 12689*, RSA) is an intergeneric cross between some population of *C. nauseosus* and a species of *Haplopappus*. Flower number (Table 1) reinforces the probability of hybridity.

An intersectional hybrid was obtained in the Claremont garden. Seed from *C. albidus* produced a plant with pannose tomentum characteristic of stems of *C. nauseosus*; flower color (pale lemon yellow) was intermediate between the putative parents. Several floral features in that propagation, but absent in *C. albidus*, point to hybridity: secretory canals in the achenes, absence of glandular trichomes on the achenes, and trichomes on the corolla tube.

TERATOLOGICAL ANATOMY

Normal and abnormal flowers are not mutually exclusive categories. Determining teratisms is largely subjective. Further, use of teratism in phylogenetic studies is widely debated (Takhtajan, 1954). Nevertheless, the intensive nature of this study enables a better determination of the extent and significance of anatomic teratologies.

Frequency of certain teratological types are listed in Table 6; more than

one type can occur in the same head. Additional types are discussed in the text, and some are illustrated in Figs. 33-37. Six-merous flowers and flowers with additional corolla vasculature (midveins) are the most frequent forms. Unfused lateral veins in the corolla (Fig. 35) are restricted to *Nauseosi*. Teratisms vary in degree of occurrence. In *A 2714* (Fig. 34), every flower of the four heads sectioned has midveins, whereas only one abnormal flower was found in *A 1606* (Figs. 36-37) in the two heads sectioned.

Heads with one or more flowers positioned among the involucral bracts in addition to the normally-positioned central group occur in some populations of *C. linifolius* (*A 920, A 1860*). An extreme case (Fig. 33) has four such flowers. They are abnormal in anatomy as well as position. Some have free floral parts that are normally fused in composites; others have abnormal fusions, such as stamens with the style. The flowers produced in the usual position inside the bracts are normal.

Flowers of *A 2714* (*C. viscidiflorus* ssp. *viscidiflorus*), in addition to 10 veins in the corolla tube, have unusual growths inside the corolla tube opposite the extra veins (Fig. 34). They are possibly staminodes. Such structures were seen in one or two flowers of other taxa; in *A 2714*, they appear in all flowers. Secretory canals are associated with the extra vasculature, but not with the normally-positioned five bundles (Fig. 34). Those secretory canals extend down the corolla tube well below the point of staminal departure, which is much greater distribution than normal (see Fig. 24, zone III).

One flower of *A 1606* (*C. humilis*) has two ovules, and in addition to the outer row of ovarian bundles associated with the corolla vasculature, there is an inner, strictly gynoecial bundle (Fig. 36). That inner bundle enters the trifid style; a total of six bundles enter the style base (Fig. 37).

DISCUSSION

To properly evaluate morphological features for use in biosystematics, one must first determine the relative stability of those features. That may be accomplished by garden studies. Uniform gardens allow comparison of behavior of plants with different heredity in the same environment; growth of the plants in varied environments permits observation of the interplay between heredity and environment. The work of Clausen, Keck, and Hiesey (1940) is a classic in that field; however, to my knowledge, the technique has not been extensively applied to anatomic studies.

Gardens used in this study presented greater environmental extremes than most taxa encounter in nature (Table 2); therefore, anatomic variation found in the gardens likely is greater than that found in natural populations. It follows, then, that features that remain constant, or relatively so, in the three environments (Table 4) can be validly used for taxonomic comparisons.

Stability of internal structures is generally conceded to be greater than that in features of external morphology. The concept is upheld in this study. Tissue composition, vasculature, and particularly the amount and distribution of secretory canals are extremely constant. The greatest variability is

found in achenial trichomes of *C. vaseyi*. Here the variation is quantitative rather than qualitative. The increase in twin-hairs was so great in the Claremont garden that it completely masked the glandular achenes. Both gardens were outside the natural range of *C. vaseyi*. Apparently differing environments enhanced different expressions of the genotype.

The close genetic control of features of floral anatomy permits use of the data at all taxonomic levels to help determine distinctiveness of taxa and to determine phylogenetic relationships.

Taxonomy

Subspecies. Data from floral anatomy support current taxonomic interpretations in many cases; however, two notable exceptions are discussed here. Hall and Clements (1923) described three subspecies for *C. pulchellus*. Floral anatomy of that species varies sufficiently to imply subspecies, but the patterns of variability do not coincide with the subspecies of Hall and Clements. Study of the problem is continuing.

Perhaps the greatest value of data from floral anatomy at this level is clarification of the infraspecific relationships in *C. parryi*. Hall and Clements (1923) list 10 subspecies. Their and my concepts of phylogeny are reproduced in Fig. 38, left and right, respectively. Floral anatomy contributed to my concept. Hall and Clements (1923, pp. 203-206) describe two major divisions of *C. parryi*: 1.) the primitive stock that developed into ssp. *parryi* in the Rocky Mountains and ssp. *bolanderi, latior,* and *imulus* in the Sierra Nevada; 2.) the second division composed of two "apparently nautral groups"—the *asper* line and the *howardii* line. Closeness of subspecies in their phylogenetic chart is considered to reflect genetic relationship.

Several major differences between the two schemes (Fig. 38) are apparent. The hybrid, *C. bolanderi,* is not included in my concept as its origin does not involve taxa of *C. parryi* (Anderson and Reveal, 1966). Hall and Clements considered ssp. *affinis* as a minor variation of ssp. *attenuatus; affinis* is more appropriately allied with ssp. *parryi* as absence of corolla lobe trichomes indicates (Table 1). The *asper* line of Hall and Clements is unnatural, and ssp. *vulcanicus* is considered much less specialized than they suggested. The four undescribed taxa of the *C. parryi* complex listed in Table 1 are very specialized populations, more so than any shown in Fig. 38.

Species. Several species have been placed in *C. viscidiflorus; C. molestus* (Blake, 1940) and *C. spathulatus* (as *ludens;* Shinners, 1964) have been considered varieties of *C. viscidiflorus,* and *C. humilis* and *C. linifolius,* as subspecies (Hall and Clements, 1923).

Chrysothamnus molestus is very distinct from *C. viscidiflorus* and belongs to a different section of the genus. The closely related *C. spathulatus* and *C. linifolius* differ from *C. viscidiflorus* in that the first species has nearly glabrous achenes, fewer secretory canals, and, occasionally, ray flowers, and the second has more flowers per head and more vasculature and secretory canals in the inflorescence. Achenes of *C. humilis* have a distinctive trichome complement (Table 1), and heads have fewer flowers. Other disting-

uishing features of these taxa have been enumerated (Anderson, 1964). On the other hand, floral anatomy does not support the distinctness of *C. axillaris* (Keck, 1958) as a separate species; it varies only slightly from *C. viscidiflorus* ssp. *stenophyllus*.

Section. Of the four sections of *Chrysothamnus*, *Pulchelli* is the most strikingly delineated by floral anatomy, particularly in trichomes and floral ontogeny. *Nauseosi* is characterized by presence of stylar secretory canals and usually has trichomes on the corolla tube. Sections *Chrysothamnus* and *Pulchelli* lack stylar secretory canals and have trichomes on the corolla tubes in only a few taxa. Involucral structure and trichomes are uniform and distinctive in *Punctati*; however, its species are very dissimilar in secretory canal distribution.

Genus. Many students of Compositae agree *Chrysothamnus* is closely related to and possibly derived from *Haplopappus*, but views vary as to the closest point of relationship. Hall and Clements (1923) propose a close affinity between *C. paniculatus* and *H. sonoriensis* of section *Ericameria*. Others (Gray, 1873; Greene, 1895) suggest *C. parryi* is most primitive and close to *H. macronema* of section *Macronema*

Chrysothamnus paniculatus and *Haplopappus sonoriensis* differ conspicuously in floral anatomy in that *H. sonoriensis* and other taxa of section *Ericameria* have well developed secretory canals in the achenes and corollas (except *H. pyramidatus*, which is anomalous in other ways). Further, *H. sonoriensis* has glandular trichomes on the involucral bracts that are terminated by a long thickwalled, finger-like cell. That kind of trichome is present on the receptacle of *H. laricifolius* (*A 3038*) but absent in all *Chrysothamni*.

Secretory canal distribution and trichome patterns are similar in *C. parryi* and *H. macronema*. That, coupled with details of the biology of *C. bolanderi* (Anderson and Reveal, 1966), suggest the *C. parryi—H. macronema* connecting point between the two genera is the closer.

Phylogeny

Determination of evolutionary trends in the genus can be made by comparing floral anatomy of *Chrysothamnus* to that of other Compositae and by comparing it with data on *Chrysothamnus* from such other areas as morphology and cyto'ogy.

Col (1904) found an evolutionary trend in the secretory apparatus of Compositae. Less specialized taxa have more secretory canals than do the more advanced taxa. In *Chrysothamnus*, *C. parryi* ssp. *parryi* and ssp. *vulcanicus* (Table 1) have the most floral secretory canals; *C. albidus* and *C. paniculatus* have the least (present only in the involucre).

Several writers (Babcock, 1947; DeJong, 1965; Koch, 1930; Stebbins, 1940) have noted that more vascular strands in the achenes represent a primitive feature in various Compositae. In *Chrysothamnus*, several subspecies of *C. parryi* and a few of *C. nauseosus* consistently have more ovarian vascular bundles than do other taxa.

The most primitive composite flowers have 15 veins in the corolla, one mid-

vein and two laterals per member of the 5-merous flower (Carlquist, 1961). Phylogenetic trends include loss of the midvein and fusion of adjacent laterals to produce a 5-veined corolla. Floral teratologies (Table 6) are instructive if they reflect phylogeny, either as atavisms or vestiges. Greater vascularization is indicated by unfused laterals and extra corolla veins (midveins); tristyly and 6-merous flowers might relate to extra vascularization in those parts. *Nauseosi*, particularly *C. parryi*, has the greatest amount of these combined teratisms. *Since* evolutionary trends adduced from floral aberrations are positively correlated with those from other areas, their use seems acceptable for *Chrysothamnus*. Similarly, the 4-merous flower as in *C. viscidiflorus* and *C. humilis* might reflect a continuing trend of reduction and specialization.

A correlation between amounts of vascularization and secretory canals is probable; it is definitely suggested in teratological forms. Corollas of *C. viscidiflorus* normally lack secretory canals, but in *A 2714* they are present along the extra (midvein) bundles (Fig. 34) and extend down the corolla tube past the point of staminal insertion.

Cronquist, in reviewing phylogeny in Compositae (1955), suggested several features as being primitive in the family. The following are appropriate to the discussion here: heads few, each with many flowers; involucres leafy, several seriate; and rays present, pistillate, fertile. In *Chrysothamnus*, the first two features apply best to *C. parryi* ssp. *parryi*. The inflorescence has fewer heads than in most taxa; each head contains 10—20 flowers, and the phyllaries are more herbaceous and leaf-like than in any other taxa. Ray flowers are found occasionally only in *C. spathulatus*; however, that Compositae probably lacked ray flowers primitively (Carlquist, 1961) does not alter the apparent primitive position of *C. parryi* ssp. *parryi*. Data from cytology support that position (Anderson, 1969); *Chrysothamnus parryi* ssp. *parryi* has the least specialized karyotype known to the genus.

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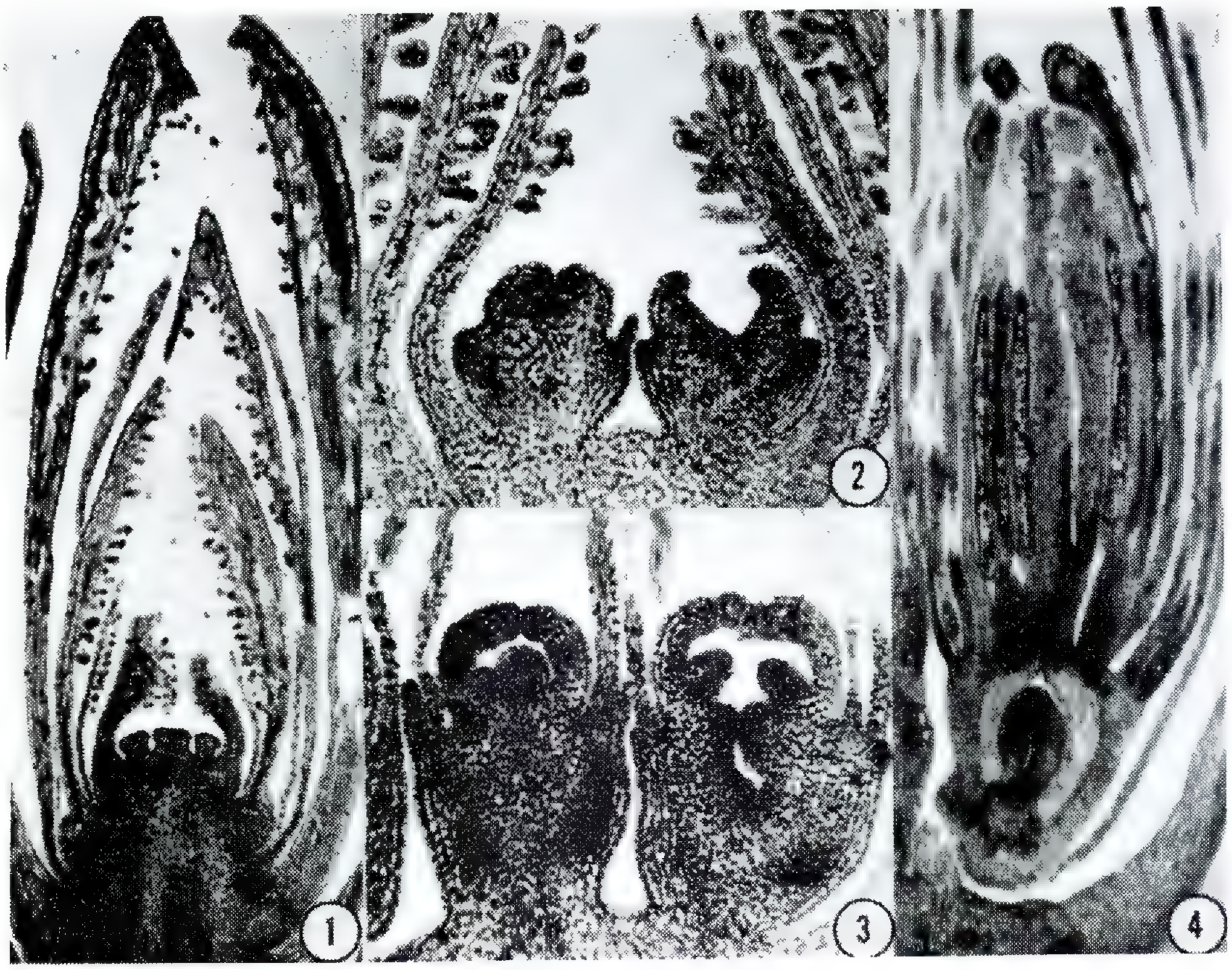
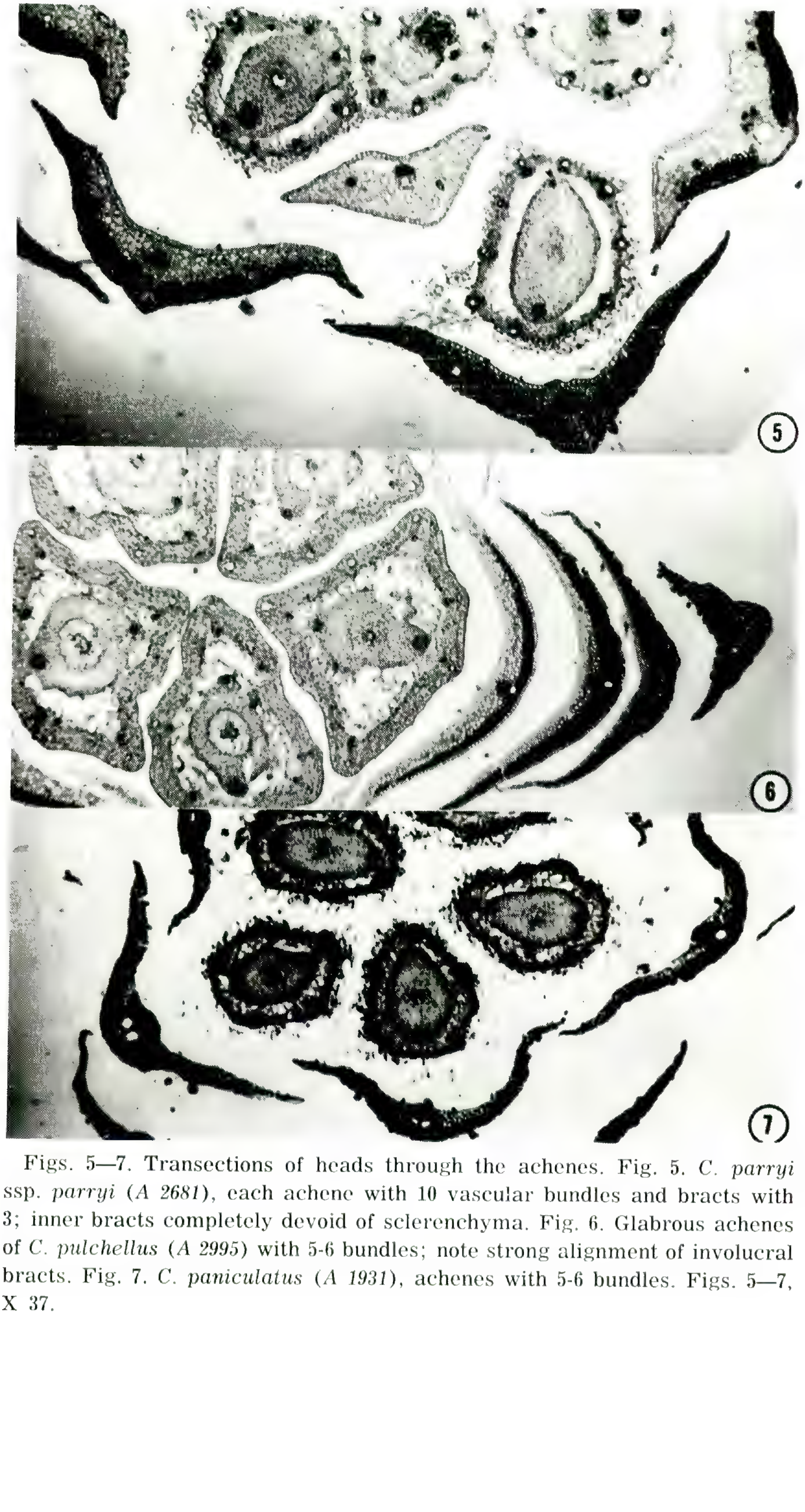


Figs. 1—4. Floral ontogeny in *C. pulchellus* (*A 2590*). Fig. 1. Longisection of head 5 mm long showing three flower primordia and extensive bract development. Fig. 2. Portion of head 6 mm long showing two developing flowers with corolla and pappus differentiated. Fig. 3. Flowers from head 7 mm long showing extensive pappus and initial development of androecium and ovule. Fig. 4. Portion of head 11 mm long with flower undergoing meiosis in megaspore mother cell. Figs. 1, 4, X 30. Figs. 2-3, X 115.



Figs. 5—7. Transections of heads through the achenes. Fig. 5. *C. parryi* ssp. *parryi* (*A 2681*), each achene with 10 vascular bundles and bracts with 3; inner bracts completely devoid of sclerenchyma. Fig. 6. Glabrous achenes of *C. pulchellus* (*A 2995*) with 5-6 bundles; note strong alignment of involucral bracts. Fig. 7. *C. paniculatus* (*A 1931*), achenes with 5-6 bundles. Figs. 5—7, X 37.

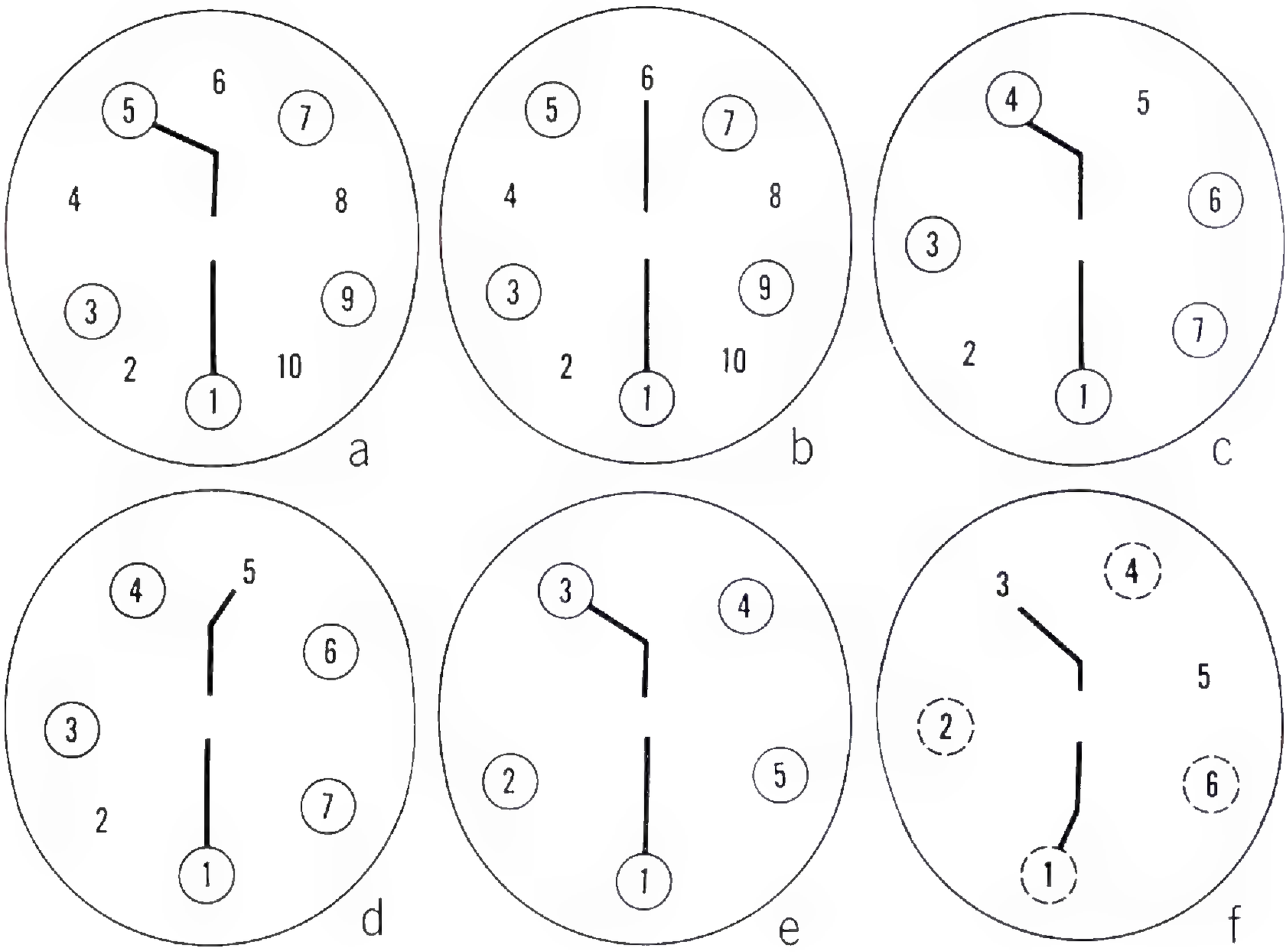
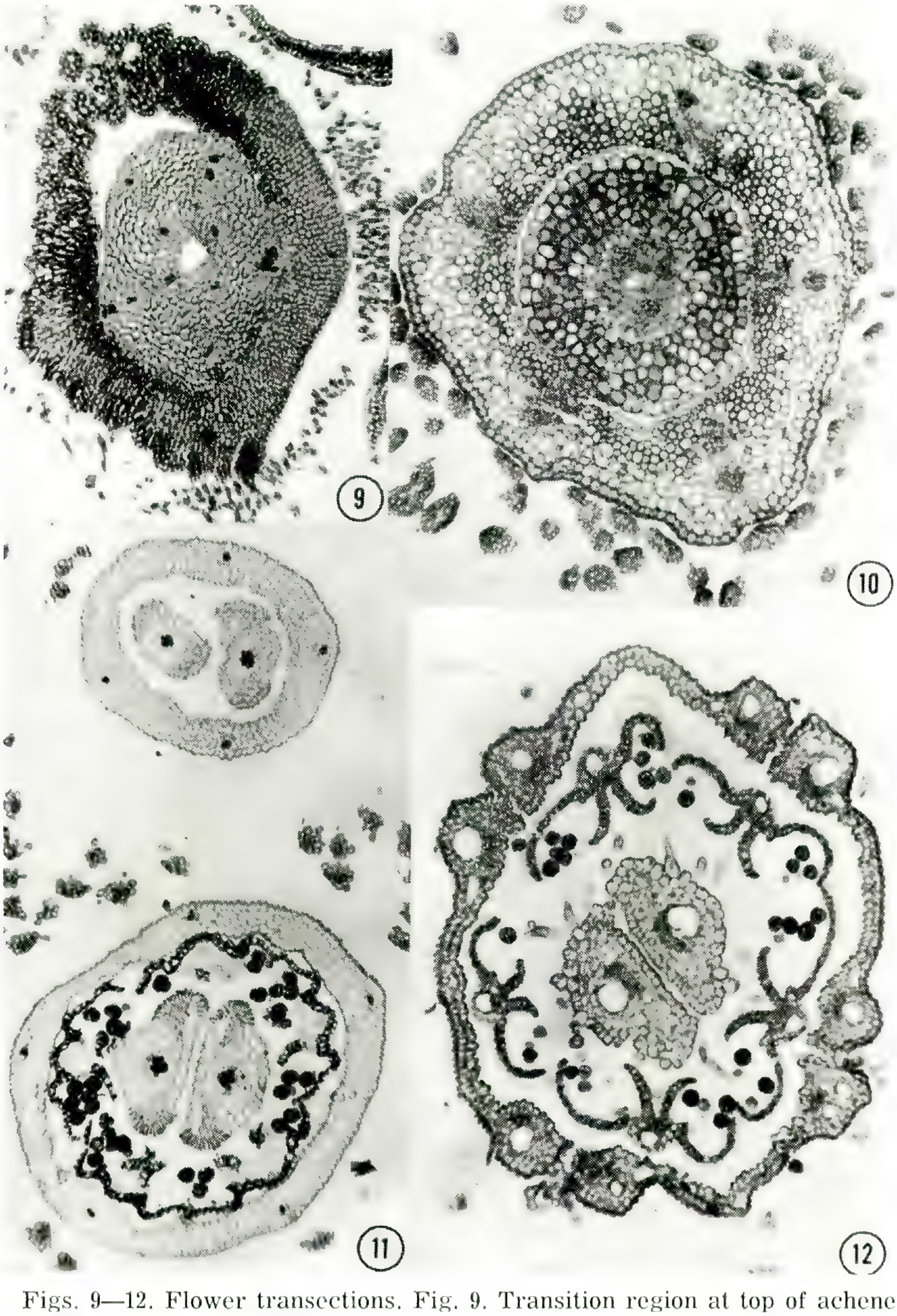
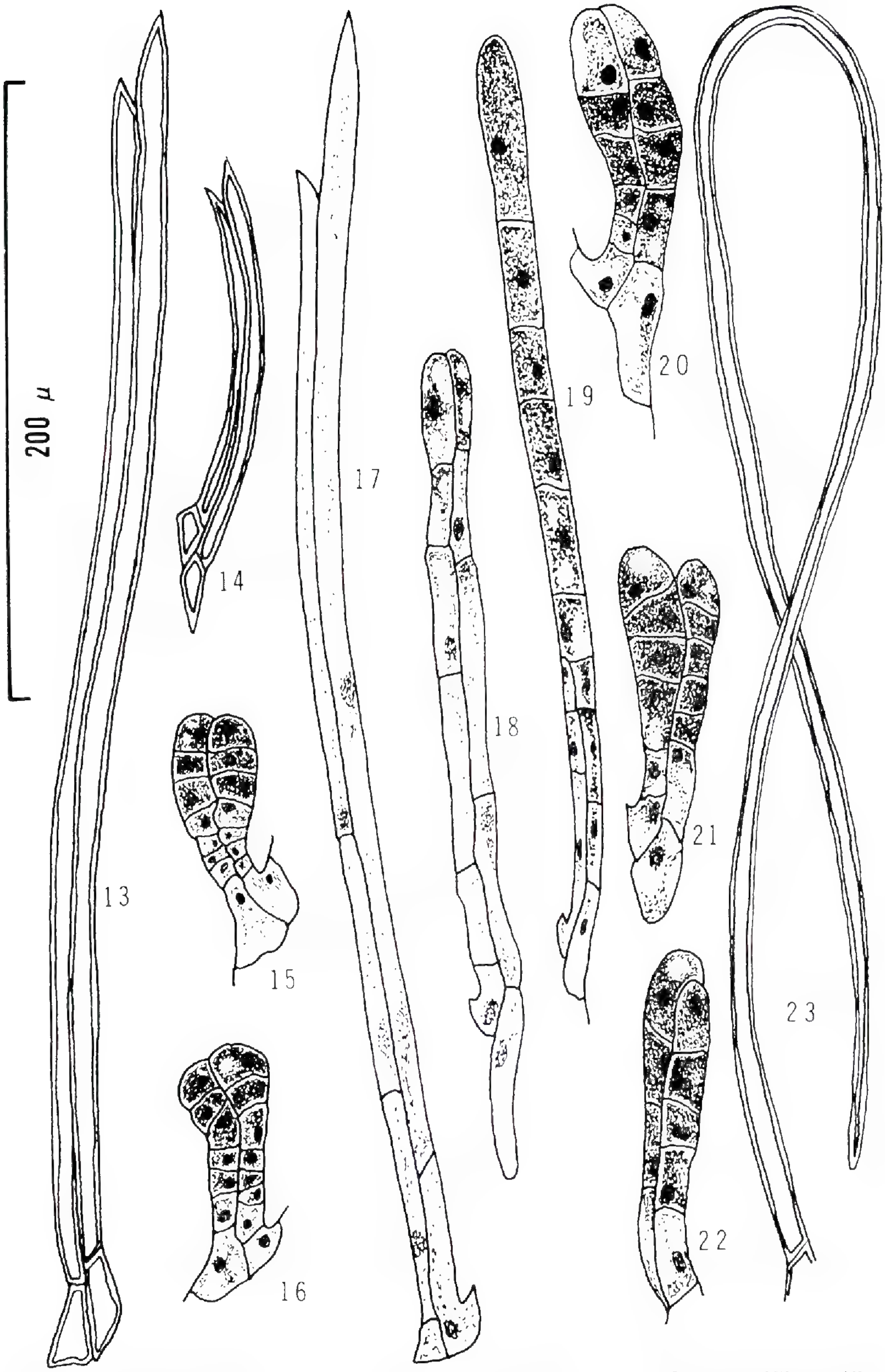


Fig. 8. Diagrammatic patterns of ovarian vasculature and transition to corolla, stamens, and style. Fig. 8a-8e. Disc flowers. Numbers represent ovarian vascular bundles; encircled numbers are those that divide to supply the corolla and androecium, and solid lines indicate the ovarian bundles that supply traces to the style. Fig. 8f. Ray flower; broken circles represent ovarian bundles that continue into corolla (androecium absent).



Figs. 9—12. Flower transections. Fig. 9. Transition region at top of achene of *C. nauseosus* ssp. *albicaulis* (*A 2083*) with ring of pappus, five bundles of the corolla base, and four at the style base. Fig. 10. *C. depressus* (*A 993*), cells of corolla and style base with heavy secondary walls. Fig. 11. Ray and disc flowers of *C. spathulatus* (*A 3209*), both lacking secretory canals. Fig. 12. *C. parryi* ssp. *parryi* (*A 2681*), secretory canals present in corolla lobes, anthers, and style branches. Figs. 9—12, X 86.



Figs. 13—23. Trichomes. Figs. 13—14, twin-hairs of achenes; Figs. 15—16, glandular hairs of achenes; Figs. 17—19, villi of corolla tubes; Figs. 20—22, glandular hairs of corolla tubes; Fig. 23, shag-hair of corolla lobe. Fig. 13. *C. viscidiflorus* ssp. *stenophyllus* (*A 1746*). Figs. 14—15. *C. vaseyi* (*A 936* and *A 1002*, respectively). Fig. 16. *C. molestus* (*A 3148*). Figs. 17—18. *C. parryi* ssp. *asper* (*A 1919* and *A 2043*, respectively). Fig. 19. *C. nauseosus* ssp. *albicaulis* (*A 2001*). Fig. 20. *C. viscidiflorus* ssp. *lanceolatus* (*A 2735*). Fig. 21. *C. humilis* (*A 2950*). Fig. 22. *C. paniculatus* (*A 1925*). Fig. 23. *C. parryi* ssp. *nevadensis* (*A 2952*).

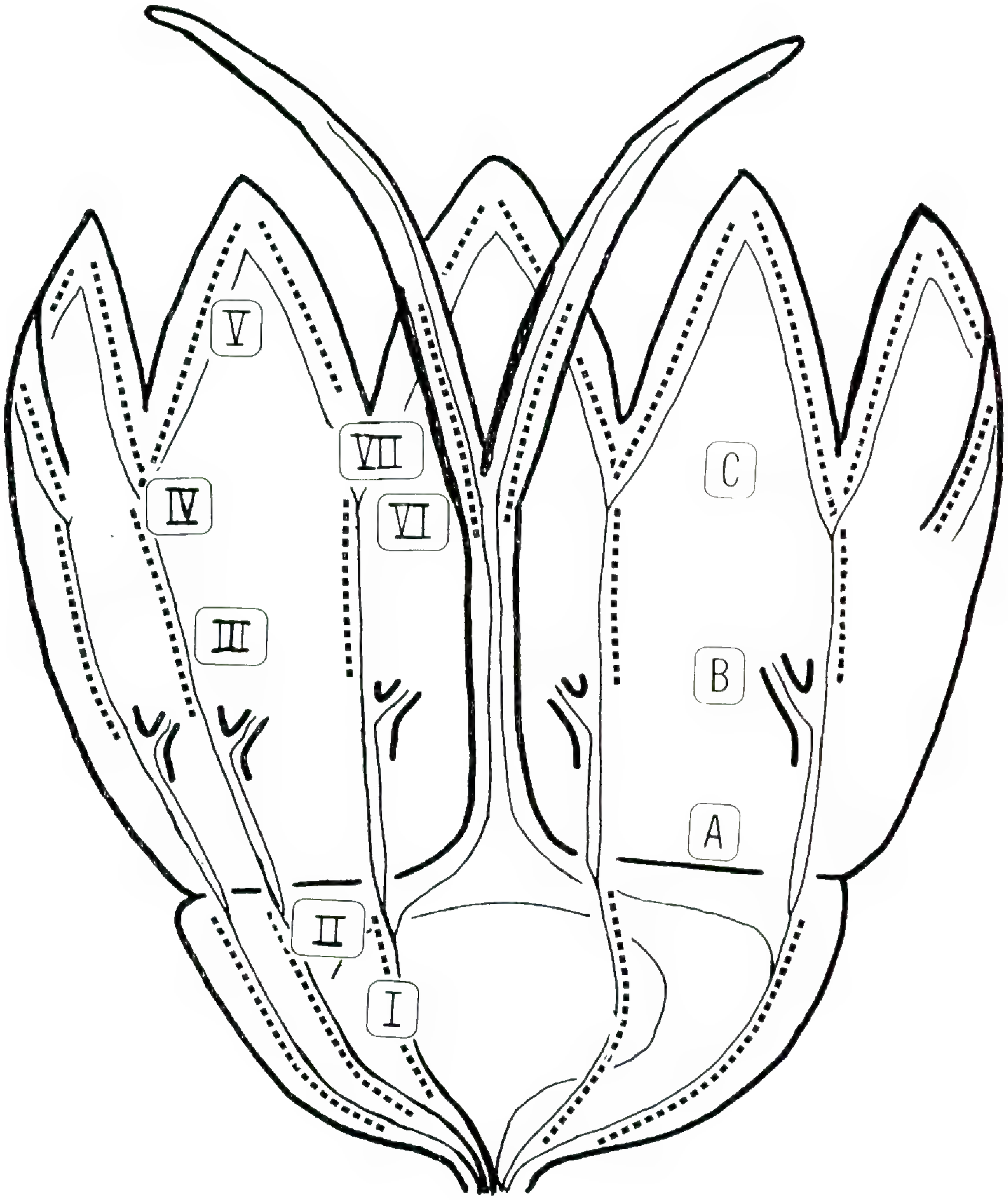
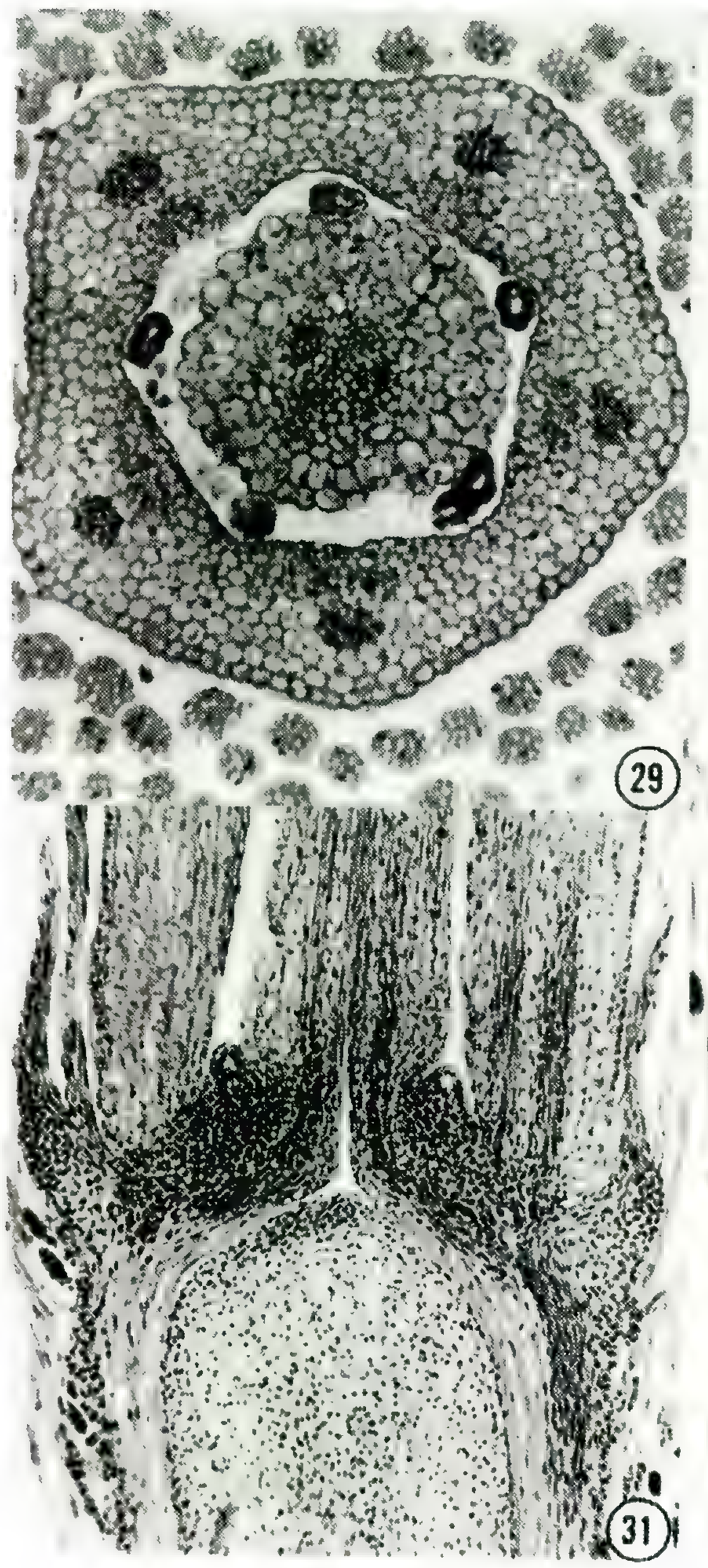
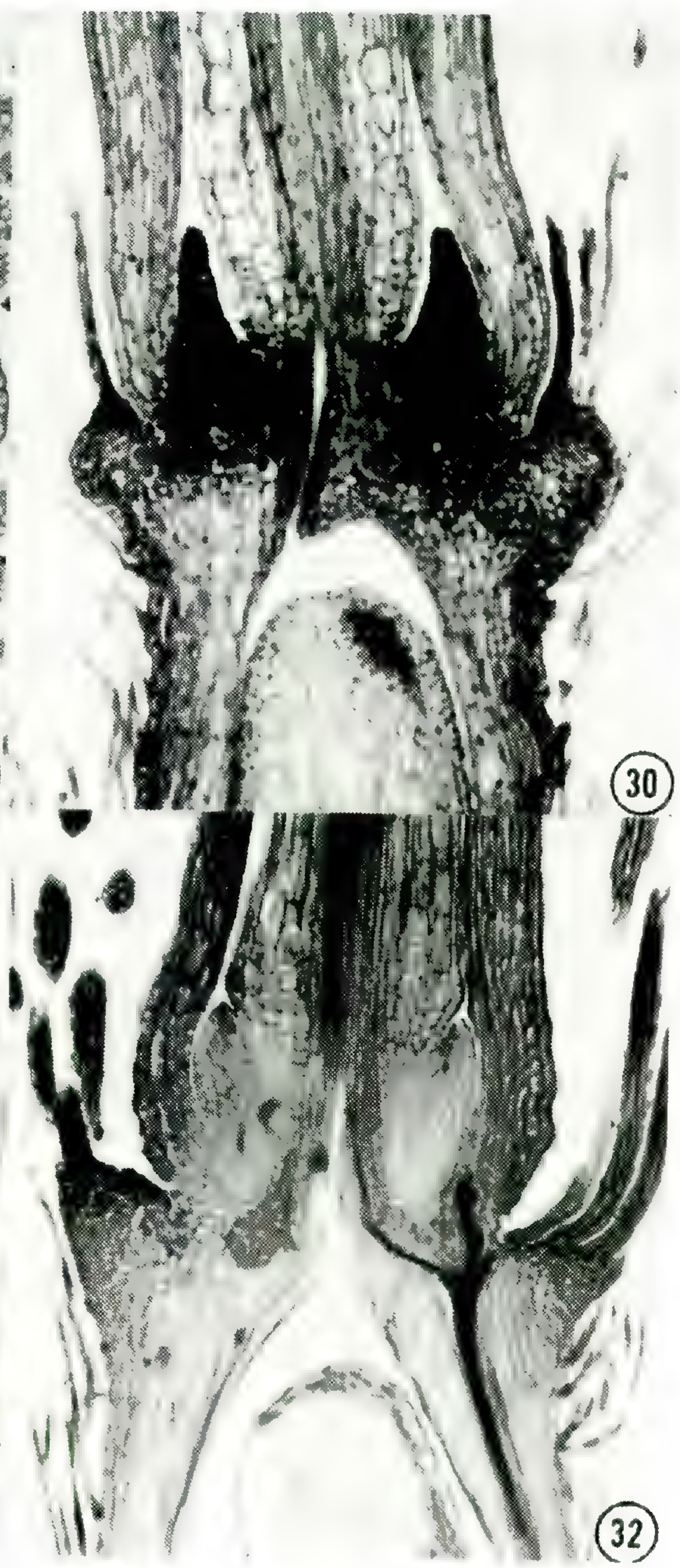


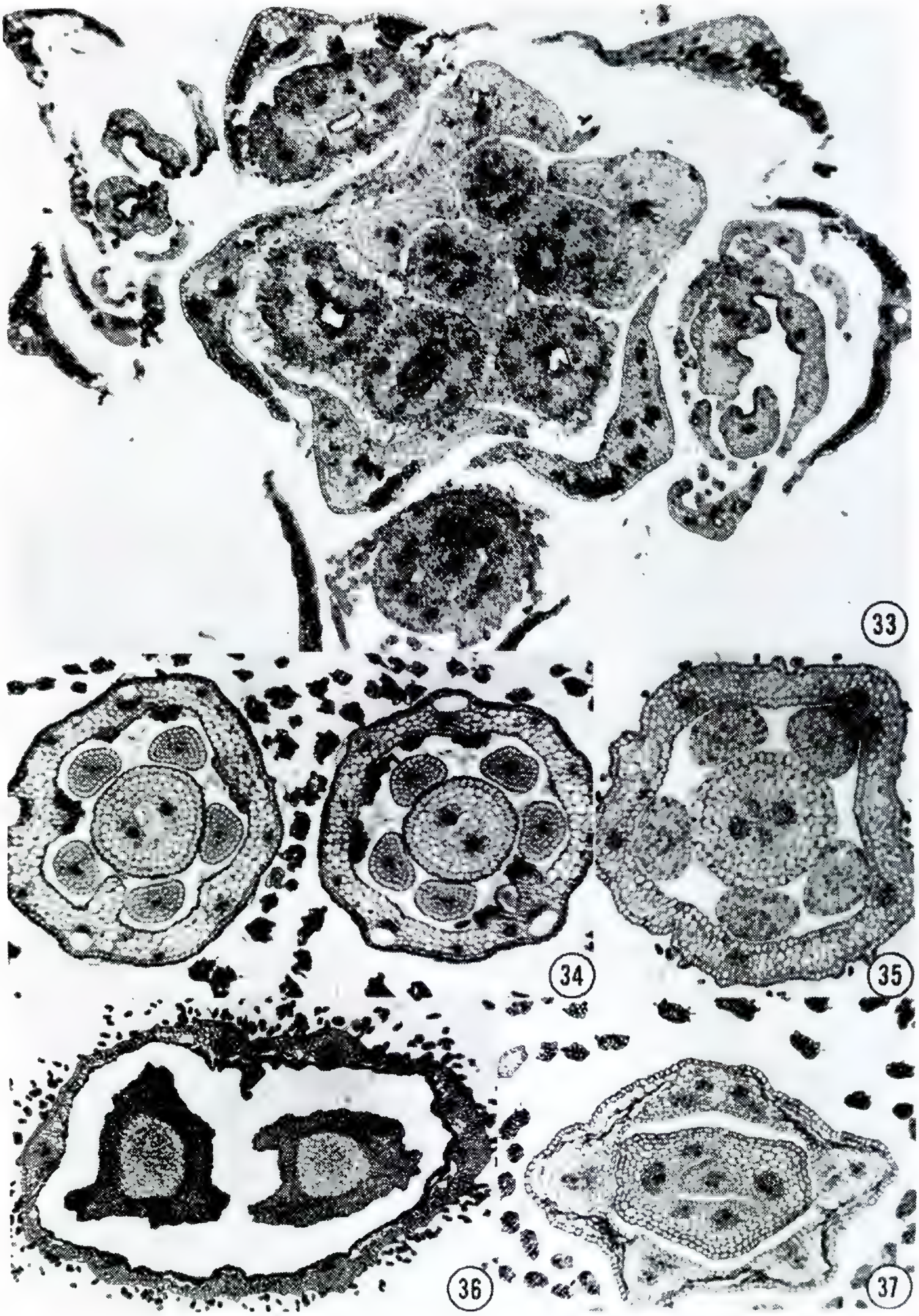
Fig. 24. Diagrammatic flower with stamens removed. Fine lines represent vasculature; broken lines, maximum secretory canal distribution. Roman numerals indicate zones to determine secretory canal abundance; see headings in Table 1. Letters A, B, and C are levels of corolla used to determine thickness (cell number) for Table 1.

Figs. 25—28. Transections of nearly mature achenes (cypselas). Fig. 25. *C. parryi* ssp. *parryi* (*A 1973*), note prominent sclereids of ovule wall. Fig. 26. *C. nauseosus* ssp. *albicaulis* (*A 1773*). Fig. 27. *C. spathulatus* (*A 3008*), sclereids of ovule wall less prominent, packets of sclerenchyma in ovary wall. Fig. 28. *C. pulchellus* (*A 3056*), most of ovary wall heavily sclerosed. Figs. 25—28, X 96.





Figs. 29—32. Nectaries. Fig. 29. Transection at corolla base of *C. nauseosus* ssp. *consimilis* (*A 1921*) showing five peaks of nectary ring around base of style. Fig. 30. Longisection of *C. paniculatus* (*A 1931*). Fig. 31. *C. humilis* (*A 2950*), glandular trichomes intermixed with twin-hairs on achene. Fig. 32. *C. parryi* ssp. *vulcanicus* (*A 2035*), note vascular trace to base of pappus in addition to those going to corolla and style. Fig. 29, X 105. Figs. 30—31, X 140.



Figs. 33—37. Teratological forms. Fig. 33. Head of *C. linifolius* (*A 1860*) with four abnormal flowers positioned among the phyllaries outside the central cluster of six. Fig. 34. Corolla transections of *C. viscidiflorus* ssp. *viscidiflorus* (*A 2714*) with five additional bundles (midveins) in the tube; secretory canals and abnormal growths (staminodes?) are associated with the additional bundles. Fig. 35. Corolla tube of *C. nauseosus* ssp. *salicifolius* (*A 977*) with unfused lateral bundles in upper right-hand corner. Fig. 36. Bicarpellate ovary of *C. humilis* (*A 1606*) with two ovules and a gynoecial bundle in the ridge of the ovule wall. Fig. 37. Corolla tube of same flower (*A 1606*) showing base of trifid style with six bundles; the central one is the gynoecial bundle of the achene in Fig. 36. Fig. 33, X 40. Figs. 34—37, X 145.

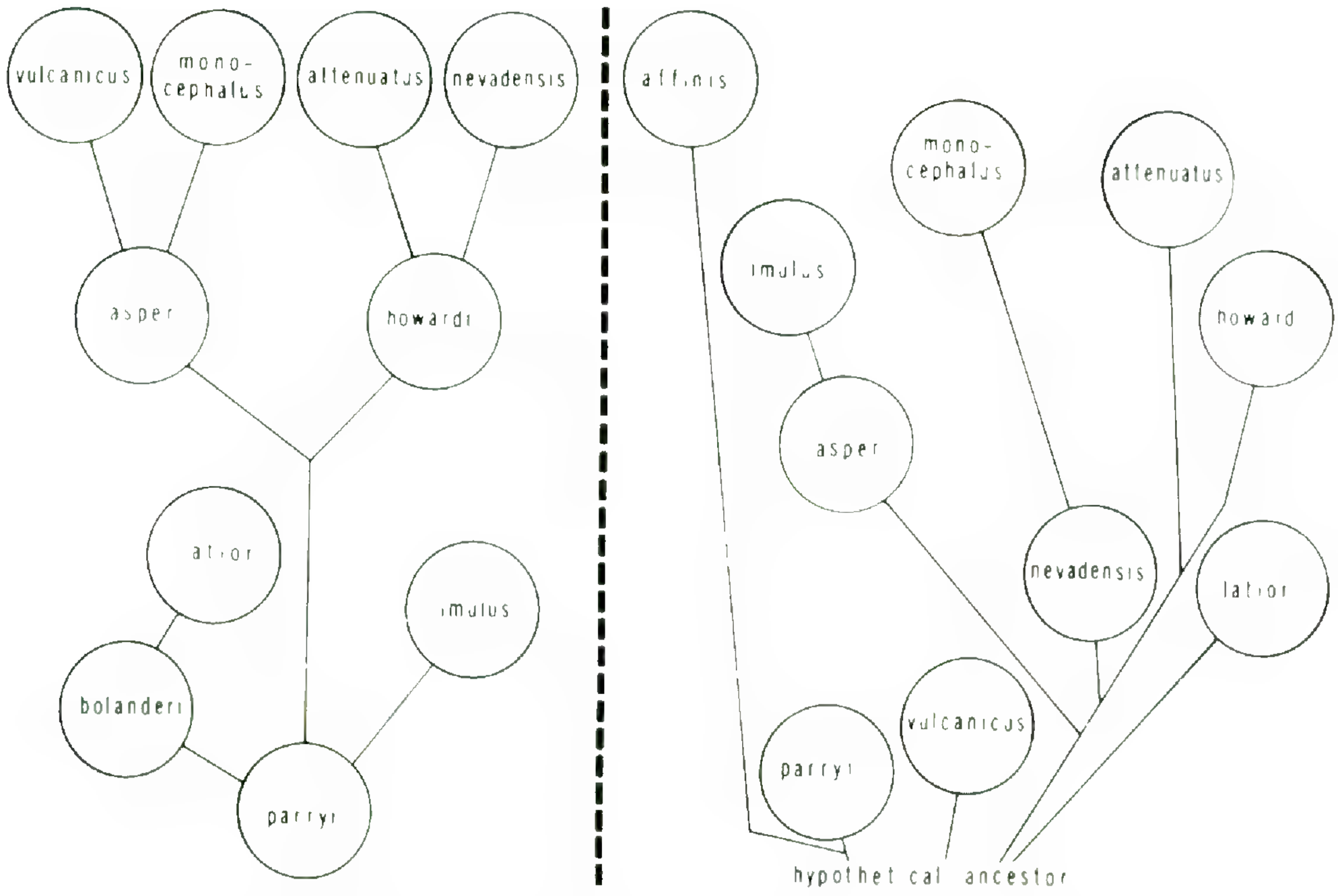


Fig. 38. Comparison of schemes on the infraspecific relationships in the *C. parryi* complex. Left—redrawn from Hall and Clements (1923) to illustrate their concept of phylogeny in the group. Right—my concept, based largely on data from floral anatomy; vertical spacing reflects degree of phylogenetic specialization.

TABLE 1. SELECTED FEATURES OF FLORAL ANATOMY IN CHRYSOTHAMNUS AND RELATED HAPLOPAPPUS

taxon and collections	*average flower number*	*ovarian bundle number* ave.	rg.	*frequency of vascular patterns seen* a b c d e	*achene secretory canal distribution* I	II	*corolla* III	IV	V	VI	*style* VII	*trichomes achene* type	frequency	length, μ	*corolla tube* type	frequency	length, μ	*corolla lobe* type	frequency	length, μ	*corolla thickness* A	B	C
NAUSEOSI																							
C. parryi ssp. affinis A2465, A2771	5.0	6.0	5-7	0 0 1 0 1	0	+	0	++	++	−	++	n	++	560	g	++	209				7	5	2
(undescribed?) A1726, A1782	5.0	5.5	5-8	0 0 0 0 1	0	0	0	+	−	0	−	n	++	672	g n	+ −	224 291				7	5	2
ssp. asper A1683, A1919, A2024, A2043	5.4	8.5	7-10	2 1 1 0 0	−	+	+	+	++	−	++	n	++	414	g n	++ ++	177 427	n	−	800	8	5	2
ssp. attenuatus A988, A1523	5.3	7.2	5-8	0 0 4 1 0	−	+	−	++	+	0	+	n	++	504	g	++	181	n	+	530	8	5	2
(undescribed?) A1658, A1660, A1662	5.0	5.1	5-6	0 0 0 0 4	−	+	0	++	+	0	++	n	++	525	g n	++ −	118 358	n	−	480	7	5	2
ssp. howardii A1536, A2691, A2768	5.0	7.0	5-9	0 0 1 1 0	−	++	−	++	+	−	+	n	++	358	g	++	177	n	++	900	8	5	3
ssp. imulus A1923, Jones in 1900	10.0	9.1	8-10	1 0 0 0 0	0	+	0	+	0	0	+	n	++	410	n	+	287	n	++	750	7	5	2
ssp. latior A2945, A2949	5.0	9.7	8-11	2 0 0 0 0	+	++	−	++	++	−	++	n	++	571	g	+	188	n	−	92	8	5	2
ssp. monocephalus A2031, A2919	5.6	7.0	5-9	0 0 1 0 1	−	+	+	++	+	0	−	n	++	448	g n	+ −	145 314	n	−	490	7	5	2
ssp. nevadensis A1582, A2079, A2952	5.2	9.1	8-10	2 0 0 0 0	0	+	++	++	++	+	++	n	++	627	g n	++ +	286 538	n	++	1100	7	5	2
(undescribed?) A1561, A2966	3.0	5.3	5-6	0 0 0 0 1	0	+	+	++	++	0	−	n	++	548	g	++	150				7	5	2
ssp. parryi A912, A1818, A2526, A2681	12.2	9.7	8-11	2 4 4 2 0	++	++	+	++	++	++	++	n	++	488	g	++	225				7	5	2

Table 1. (continued—2)

taxon and collections	average flower number	ovarian bundle number		frequency of vascular patterns seen					secretory canal distribution							trichomes													
									achene		corolla				style	achene			corolla tube			corolla lobe			corolla thickness		
		ave.	rg.	a	b	c	d	e	I	II	III	IV	V	VI	VII	type	frequency	length, μ	type	frequency	length, μ	type	frequency	length, μ	A	B	C
(undescribed?) A1024	6.5	5.3	5-7	0	0	1	0	2	−	+	0	+	+	0	+	n	++	433	g	+	141				7	5	2
ssp. vulcanicus A1913, A2035	5.7	9.6	9-10	2	0	0	0	0	++	++	+	++	++	++	++	n	++	538	g	++	185	n	−	450	7	5	2
C. nauseosus ssp. albicaulis A1028, A1629, A1644, A1773, A2001, A2026, A2927	5.0	5.6	5-7	0	0	0	0	11	−	+	−	++	++	−	++	n	++	448	g n	++ −	167 251	n	−	375	7	5	2
ssp. bernardinus A1916, A2041	5.0	8.0	6-9	0	0	3	0	0	−	+	+	++	++	−	++	n	++	540	g	++	148				7	5	2
ssp. bigelovii A1850, A2432, A3051	5.0	5.7	5-6	0	0	0	0	1	−	+	−	++	++	−	++				g	+	167	n	+	520	6	5	2
ssp. ceruminosus A1934, A1939	5.0	5.2	5-6	0	0	1	1	2	−	+	0	+	++	0	++	n	++	229	g	++	145				7	5	2
ssp. consimilis A1570, A1623, A1027, A1832, A1921, A2470	5.0	5.0	5	0	0	0	0	12	−	+	0	++	++	−	++	n	++	448	g	++	145				6	4	2
ssp. graveolens A1799, A2422, A2513, A2720, A3012, A2999	5.0	6.0	5-8	0	0	1	0	3	−	+	−	++	++	0	++	n	++	352	g	++	169				7	5	2
ssp. hololeucus A1600, A1918, A1942	5.0	5.8	5-7	0	0	2	0	3	−	++	−	++	++	0	++	n	++	336	g	++	171				7	5	2
ssp. junceus A1696, A1748	5.0	5.1	5-6	0	0	0	0	1	−	+	0	++	++	0	++	n	++	571	g	++	112	n	+	240	6	4	2
ssp. latisquameus A3042, A3048	5.0	5.0	5	0	0	0	0	3	−	+	−	++	++	+	++	n	++	392	g	++	172				7	5	2

Table 1. (continued—3)

taxon and collections	*average flower number*	*ovarian bundle number*		*frequency of vascular patterns seen*	*secretory canal distribution*							*trichomes*										*corolla thickness*		
					achene		*corolla*				*style*	*achene*			*corolla tube*			*corolla lobe*						
		ave.	*rg.*	*a b c d e*	*I*	*II*	*III*	*IV*	*V*	*VI*	*VII*	*type*	*frequency*	*length, μ*	*type*	*frequency*	*length, μ*	*type*	*frequency*	*length, μ*	*A*	*B*	*C*
ssp. leiospermus A866, A1995, A2011	5.0	5.2	5-7	0 0 0 0 1	−	+	−	++	++	0	++				g	+	141				5	4	2
(undescribed?) A1739, A1752, A1753	5.0	5.4	5-7	0 0 0 0 1	−	+	0	++	++	0	++	n	−	224	g	+	250	n	−	595	6	4	2
ssp. mohavensis A1686, A1932	5.0	5.2	5-6	0 0 0 0 4	−	+	+	++	++	0	++	n	++	336	g	+	157				6	5	2
ssp. nanus Cronquist & Preece 6812, Yates 2	5.0	5.0	5	0 0 0 0 1	+	++	−	++	++	0	+	n	++	481	g	+	157				7	5	2
ssp. nauseosus A2578, A2707	5.0	5.0	5	0 0 0 0 1	−	++	+	++	++	0	++	n	++	435	g	++	142				5	4	2
ssp. psilocarpus A1531, A2070, A2886	5.0	5.8	5-6	0 0 2 0 1	−	+	0	++	++	0	+				g	++	121				6	5	2
ssp. salicifolius A977, A1009	5.0	6.9	5-8	0 0 2 0 1	0	++	0	++	++	0	++	n	++	448	g	++	160				7	5	2
ssp. turbinatus A884, A1729, A2530	5.0	5.3	5-7	0 0 1 0 3	0	+	−	++	++	0	++	n	++	442	g n	++ −	164 459	n	++	500	7	5	2
(undescribed?) A1771, A1778	5.0	10.4	10-12	0 1 0 0 0	+	++	−	++	++	0	++	n	++	347	g n	+ −	153 870	n	−	370	7	5	2
(undescribed?) A1756, A1849	5.5	11.2	10-12	0 1 0 0 0	+	++	0	++	++	0	++	n	++	426	g	+	204				7	4	2
ssp. viscosus Munz 12689 (RSA)	8.0	5.0	5	0 0 0 0 1	−	++	0	++	++	0	++	n	++	384	g	+	104				5	4	2

Table 1. (continued—4)

taxon and collections	*average flower number*	*ovarian bundle number*		*frequency of vascular patterns seen*					*secretory canal distribution*							*trichomes*													
									achene		*corolla*				*style*	*achene*			*corolla tube*			*corolla lobe*			*corolla thickness*		
		ave.	*rg.*	*a*	*b*	*c*	*d*	*e*	*I*	*II*	*III*	*IV*	*V*	*VI*	*VII*	*type*	*frequency*	*length, μ*	*type*	*frequency*	*length, μ*	*type*	*frequency*	*length, μ*	*A*	*B*	*C*
CHRYSOTHAMNUS																													
C. linifolius A1487, A1860, A2500, A2702, A2738	5.5	8.6	6-10	3	7	1	0	0	−	+	0	−	++	0	0	n	++	414							8	5	2
C. spathulatus A2052, A3008, A3022, A3209	5.0	6.2	5-9	0	0	1	4	2	0	−	0	0	++	0	0	n	−	138							8	6	3
C. albidus A853, A1586, A2963	5.0	7.1	5-10	0	0	0	2	0	0	0	0	0	0	0	0	n g	++ +	450 73							7	6	2
C. greenei A878, A1838, A2433	4.5	5.8	5-7	0	0	1	0	6	0	−	0	+	++	0	0	n	++	482							9	6	2
C. viscidiflorus ssp. elegans A1569, A1983, A2885	4.0	6.9	5-7,10	1	0	1	0	3	0	−	−	+	++	0	0	n	++	305	g	−	60				9	7	3
ssp. lanceolatus A1563, A2473, A2717, A2737, A2757, A2888	4.3	6.0	5-8	0	0	5	0	3	0	+	0	−	+	0	0	n	++	336	g	+	128				8	6	2
ssp. latifolius A1611, A1614	7.0	6.4	5-9	0	0	3	0	1	0	−	0	+	++	0	0	n	++	481							7	6	2
ssp. planifolius A1853, A2094	4.4	7.2	6-10	0	0	4	0	0	0	−	0	0	+	0	0	n	+	392							10	7	2
ssp. puberulus A1961, A2005 ,A2017	5.0	6.1	5-8	0	0	0	2	2	0	+	0	+	++	0	0	n	++	302							9	6	2
(undescribed?) A1935, A1936, A2055	5.0	5.0	5	0	0	0	0	4	0	−	0	+	++	0	0	n	++	402							9	6	3

Table 1. (continued—5)

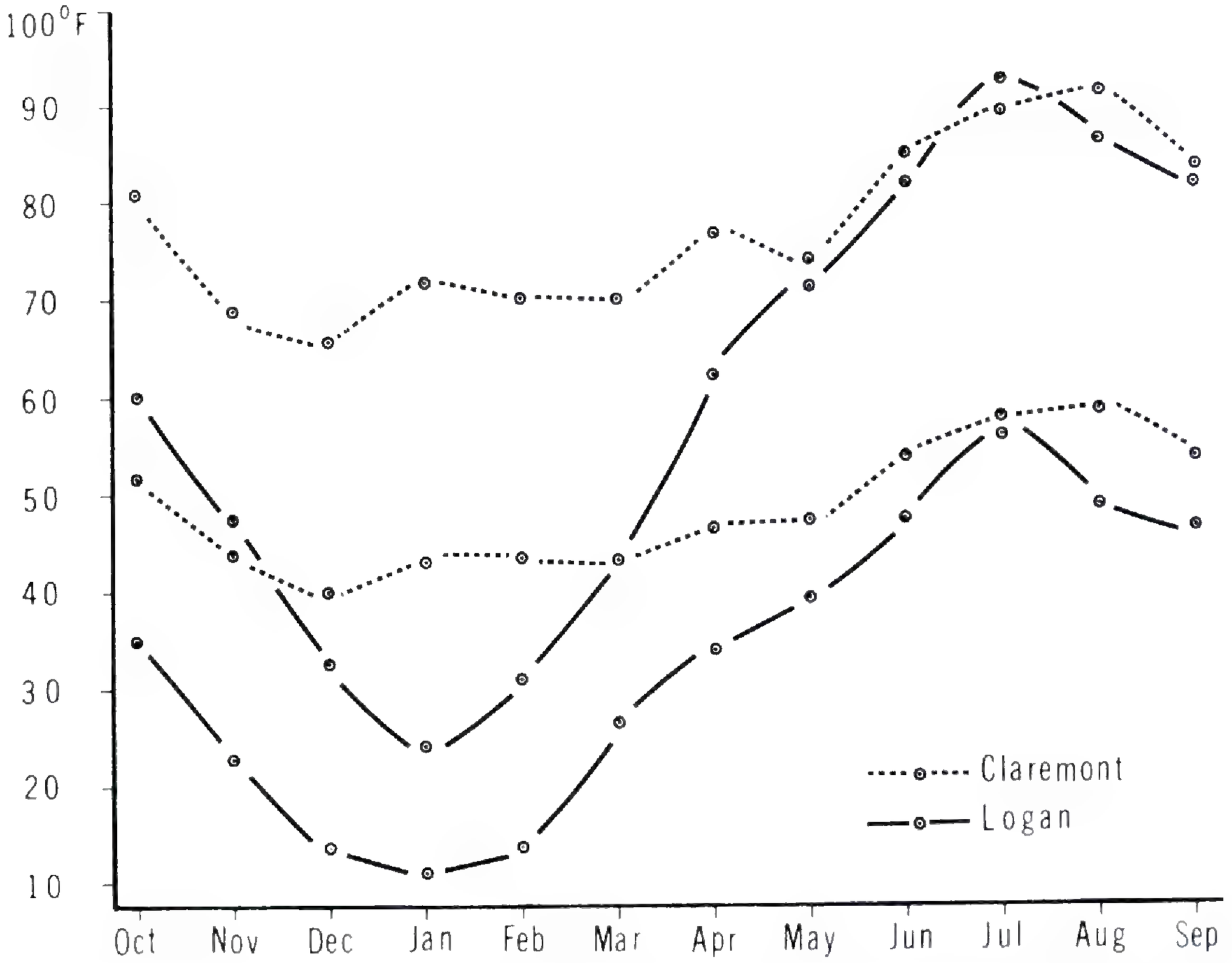
taxon and collections	average flower number	ovarian bundle number		frequency of vascular patterns seen	achene		secretory canal distribution corolla				style		trichomes achene			trichomes corolla tube			trichomes corolla lobe			corolla thickness		
		ave.	rg.	a b c d e	I	II	III	IV	V	VI	VII	type	frequency	length, μ	type	frequency	length, μ	type	frequency	length, μ	A	B	C
ssp. pumilus A2692, A2701, A2730	4.3	6.2	5-8	0 0 2 1 1	0	+	0	+	++	0	0	n	++	336							8	6	3
ssp. stenophyllus A1746, A2087, A2737, Reveal 898, Reveal 1080	4.3	5.7	5-8	0 0 0 2 3	−	+	0	+	++	0	0	n	++	324							8	6	2
ssp. viscidiflorus A1701, A1922, A2004, A2669, A2714, A2756, A2944	5.0	6.5	5-8	0 0 6 1 3	−	+	−	+	++	0	0	n	++	325							8	6	3
C. humilis A1606, A2950, Sonne in 1835	3.0	6.1	5-8	0 0 2 0 4	0	−	0	+	++	0	0	g n	+ +	88 358	g n	++ −	105 190				9	7	3
PULCHELLI																							
C. vaseyi A936, A1002, A2743	5.4	7.2	5-10	0 0 3 1 3	0	+	−	++	++	0	0	g n	+ −	69 120							9	7	3
C. molestus A1840, A3148	5.5	8.0	6-9	0 0 2 2 0	++	++	−	+	++	0	0	g	+	95	g	+	85				10	7	3
C. depressus A935, A2147, A2515, A2676, A2909	5.0	8.1	7-10	1 0 1 1 0	−	+	0	++	+	0	0	g n	+ −	100 72							12	5	2
C. pulchellus A1764, A2590, A2995, A3054, A3055, A3213	5.0	6.0	5-7	0 0 0 3 3	−	+	0	+	+	0	0	n	−	213							8	6	2
PUNCTATI																							
C. teretifolius A1930, A1943, Reveal 64-13	5.0	5.8	5-6	0 0 1 1 2	0	−	−	++	−	0	++	n	++	396	g	++	105				7	5	2

Table 1. (continued—6)

taxon and collections	average flower number	ovarian bundle number		frequency of vascular patterns seen					secretory canal distribution							trichomes														
									achene		corolla				style	achene			corolla tube			corolla lobe			corolla thickness		
		ave.	rg.	a	b	c	d	e	I	II	III	IV	V	VI	VII	type	frequency	length, μ	type	frequency	length, μ	type	frequency	length, μ	A	B	C
C. paniculatus A1871, A1925, A1931	6.8	5.8	5-8	0	0	4	1	1	0	0	0	0	0	0	0	n	++	540	g	++	91				6	5	2
MACRONEMA (HAPLOPAPPUS)																														
H. bloomeri A2943	6.0	5.2	5-6	0	0	0	0	2	−	+	+	+	+	0	0	n	−	290	g	++	116				7	5	2
H. macronema A2540, A2922	20.0	6.1	5-7	0	0	1	0	1	++	++	+	++	++	0	+	n	++	392	g	++	221	g n	− −	164 255	7	5	2
H. ophitidus A2935	4.0	5.2	5-6	0	0	0	0	1	0	+	0	+	0	0	0	g n	— −	112 336	g	+	130	n	−	230	7	5	2
ERICAMERIA (HAPLOPAPPUS)																														
H. propinquus Moran 8495, Raven 16802 (RSA)	10.0	9.2	7-10	1	0	0	0	0	++	++	0	++	++	0	0	n	++	560	g	+	92	g	−	70	10	6	3
H. pyramidatus Smith 371 (POM)	11.0	2.0	2	0	0	0	0	0	0	0	0	+	0	0	0	n	++	205	g	+	145	g	++	107	7	5	2
H. sonoriensis Moran 8564	6.0	6.0	6	0	0	2	2	0	++	++	0	0	+	0	0	n	++	485	g	+	100				7	5	2
H. trianthus A3032	3.5	6.0	5-8	0	0	1	0	1	+	++	++	++	++	0	0	n	++	420	g	+	128				8	5	2

TABLE 2. ENVIRONMENTAL DATA FOR EXPERIMENTAL GARDENS

Temperatures, mean monthly maximums and minimums, for one year prior to harvest.



Garden	*Latitude*	*Elevation*	*Mean temperature*	*Precipitation*	*Soil pH*	*Soil description*
Logan	41° 46′	4850′	42.5°F	12.3″	7.7	strongly calcareous gravelly loam (Green Canyon series); substrate loose, gravelly sandy loam or loamy sand
Claremont	34° 04′	1350′	63.1°F	6.6″	7.4	very fine clay loam (San Jose series); substrate very tight hardpan and rocky clay

TABLE 3. ENVIRONMENTAL DATA FROM ORIGINAL COLLECTION SITES FOR PLANTS USED IN GARDEN STUDIES

Taxon	*Locality & Collection*	*Latitude*	*Elevation, feet*	*Ave. Annual Temperature, degrees, F.*	*Ave. Annual Precipitation, inches*
C. parryi					
ssp. attenuatus	Wasatch Co., Utah, *A988*	39° 56′	7450	39.0	15.9
ssp. parryi	Kane Co., Utah, *A1679*	37° 29′	7000	45.3	16.1
(undescribed ?)	Clark Co., Idaho, *A1024*	44° 28′	9500	E35.0	E19.4
C. nauseosus					
ssp. albicaulis	Lake Co., Oregon, *A1629*	42° 45′	4300	48.0	10.1
ssp. consimilis	Elko Co., Nev., *A1570*	41° 04′	5350	42.8	10.3
C. greenei	Millard Co., Utah, *A878*	38° 51′	5350	50.7	7.0
C. viscidiflorus					
ssp. viscidiflorus	Coconino Co., Ariz., *A1701*	36° 41′	6100	52.5	7.8
C. humilis	Humboldt Co., Nev., *A1606*	41° 53′	5700	E44.4	E6.8
C. vaseyi	Garfield Co., Utah, *A936*	37° 42′	8400	E40.2	13.7
C. depressus	Garfield Co., Utah, *A935*	37° 42′	8400	E40.2	13.7

E = estimated

TABLE 4. FLORAL ANATOMY OF CHRYSOTHAMNUS POPULATIONS GROWN IN THREE DIFFERENT ENVIRONMENTS

taxon and collections	*average flower number*	*ovarian bundle number*		*frequency of vascular patterns seen*	*achene*	*secretory canal distribution corolla*					*style*	*trichomes achene*			*trichomes corolla tube*			*trichomes corolla lobe*			*corolla thickness*		
		ave.	*rg.*	*a b c d e*	*I*	*II*	*III*	*IV*	*V*	*VI*	*VII*	*type*	*frequency*	*length, μ*	*type*	*frequency*	*length, μ*	*type*	*frequency*	*length, μ*	*A*	*B*	*C*
NAUSEOSI																							
C. parryi ssp. attenuatus A988	7.0	6.6	5-8	0 0 2 1 0	−	+	0	++	+	0	+	n	++	560	g	++	175	n	+	670	7	6	2
Logan	5.0	6.6	6-7	0 0 3 1 0	−	+	0	++	−	0	+	n	++	580	g	++	190	n	−	460	8	6	2
Claremont	5.0	7.4	6-8	0 0 1 0 0	+	++	0	++	−	0	+	n	++	448	g	++	179	n	+	540	7	5	2
ssp. parryi A1679	10.5	8.7	7-10	0 1 2 2 0	++	++	++	++	++	++	++	n	++	481	g	++	190				7	5	2
Logan	8.0	7.4	6-9	0 0 3 0 0	+	++	++	++	++	+	++	n	++	605	g	++	190				7	5	2
Claremont	7.7	7.8	6-10	2 2 9 2 0	+	++	++	++	++	+	++	n	++	515	g	++	198				7	5	2
(undescribed?) A1024	6.5	5.3	5-6	0 0 1 0 2	0	+	0	+	+	0	+	n	++	433	g	+	135				7	5	2
Logan	8.0	5.2	5-7	0 0 0 0 1	+	+	0	+	+	0	+	n	++	465	g	+	148				7	5	2
Claremont	4.5	5.0	5	0 0 0 0 2	0	+	0	+	+	0	+	n	++	445	g	+	140				7	5	2
C. nauseosus ssp. albicaulis A1629	5.0	5.8	5-7	0 0 1 0 1	+	++	+	++	++	0	++	n	++	400	g	++	195				7	5	2
Logan	5.0	5.6	5-7	0 0 0 1 1	+	++	+	++	++	+	++	n	++	336	g	++	143				7	5	2
Claremont	5.0	5.4	5-6	0 0 0 0 1	+	++	+	++	++	0	++	n	++	358	g	++	168				6	5	2

Table 4. (continued—2)

taxon and collections	*average flower number*	*ovarian bundle number*		*frequency of vascular patterns seen*	*achene*		*secretory canal distribution corolla*				*style*	*trichomes*									*corolla thickness*		
												achene			*corolla tube*			*corolla lobe*					
		ave.	*rg.*	*a b c d e*	*I*	*II*	*III*	*IV*	*V*	*VI*	*VII*	*type*	*frequency*	*length, μ*	*type*	*frequency*	*length, μ*	*type*	*frequency*	*length, μ*	*A*	*B*	*C*
ssp. consimilis A1570	5.0	5.0	5	0 0 0 0 5	0	−	0	++	++	0	++	n	++	524	g	++	159				6	5	2
Logan	5.0	5.0	5	0 0 0 0 2	−	+	−	++	++	−	++	n	++	585	g	++	155				5	4	2
Claremont	5.0	5.0	5	0 0 0 0 3	0	−	0	++	++	0	+	n	++	470	g	++	153				6	4	2
CHRYSOTHAMNUS																							
C. greenei A878	4.5	5.0	5	0 0 0 0 1	0	+	0	++	++	0	0	n	++	481							9	6	2
Logan	4.0	5.2	5-6	0 0 0 0 1	0	+	0	++	++	0	0	n	++	594							9	7	2
Claremont	4.5	6.0	5-7	0 0 1 0 1	−	+	0	++	++	0	0	n	++	470							9	6	2
C. viscidiflorus ssp. viscidiflorus A1701	4.5	5.1	5-6	0 0 0 0 1	0	+	+	+	++	0	0	n	++	582							7	5	3
Logan	4.0	6.5	6-7	0 0 2 0 0	0	+	0	+	++	0	0	n	++	582							8	5	3
Claremont	5.0	6.2	5-8	0 0 1 0 0	0	+	+	++	++	0	0	n	++	570							8	5	3
C. humilis A1606	3.0	6.7	6-7	0 0 2 0 0	0	−	0	+	++	0	0	n g	+ +	215 99	g	++	111				9	6	3
Logan	3.0	7.3	7-8	0 0 1 0 0	0	−	0	+	++	0	0	n g	+ +	230 100	g	++	112				10	6	3
Claremont	3.5	5.2	5-6	0 0 0 0 2	0	−	0	+	++	0	0	n g	+ +	291 104	g	++	109				10	6	3

Table 4. (continued—3)

taxon and collections	average flower number	ovarian bundle number		frequency of vascular patterns seen						achene			secretory canal distribution corolla				style		trichomes: achene type	trichomes: achene frequency	trichomes: achene length, μ	trichomes: corolla tube type	trichomes: corolla tube frequency	trichomes: corolla tube length, μ	trichomes: corolla lobe type	trichomes: corolla lobe frequency	trichomes: corolla lobe length, μ	corolla thickness		
		ave.	rg.	a	b	c	d	e		I	II	III	IV	V	VI	VII												A	B	C
PULCHELLI																														
C. vaseyi A936	6.0	5.9	5-7	0	0	1	0	3		0	+	−	++	++	0	0	g	+	65									9	7	4
																	n	−	119											
Logan	5.0	7.4	7-8	0	0	1	0	0		0	−	+	++	++	0	0	g	+	66									9	6	3
																	n	+	226											
Claremont	5.0	6.7	6-8	0	0	1	0	0		0	+	+	++	++	0	0	g	+	71									9	6	3
																	n	++	347											
C. depressus A935	5.0	8.2	8-10	1	0	0	1	0		0	+	0	+	+	0	0	g	+	90									12	6	3
																	n	−	103											
Logan	5.0	8.0	7-10	0	1	0	4	0		0	−	0	+	+	0	0	g	+	87									11	6	3
																	n	−	115											
Claremont	6.0	7.0	6-9	0	0	0	2	0		0	+	0	+	+	0	0	g	+	67									12	6	3
																	n	−	112											

TABLE 5. FLORAL FEATURES OF PUTATIVE HYBRIDS AND THEIR PARENTS

collection	*ave. flower number*	*ovarian trace number*		*secretory canal distribution*							*trichome length, μ*	*corolla thickness*		
		ave.	*rg.*	*I*	*II*	*III*	*IV*	*V*	*VI*	*VII*		*A*	*B*	*C*
C. parryi ssp. parryi *A2746*	10.7	10.0	10	+	+	+	+	+	+	+	g185	8	5	2
hybrid > C. parryi *A2747*	9.0	6.5	5-8	+	+	+	+	+	+	+	g199	7	5	2
hybrid — intermediate *A2748*	7.5	7.5	5-10	+	+	+	+	+	+	+	g167	7	5	2
hybrid > C. nauseosus *A2749*	6.0	7.3	6-9	+	+	0	+	+	+	+	g164	7	5	2
C. nauseosus ssp. nauseosus *A2745*	5.0	5.0	5	+	+	0	+	+	+	+	g141	6	5	2

TABLE 6. TYPE AND FREQUENCY OF FLORAL TERATOLOGIES

Taxon	*total populations sampled*	*total beads sampled*	*total number beads with teratologies*	*categories*				
				4-merous	*6-merous*	*unfused lateral veins*	*extra corolla veins*	*tristylous*
NAUSEOSI								
C. parryi	33	66	16	3	4	4	6	5
C. nauseosus	59	87	10	2	3	3	1	4
CHRYSOTHAMNUS								
C. linifolius	5	12	4	1	1	0	3	0
C. spathulatus	5	9	3	0	1	0	3	0
C. albidus	4	5	1	0	1	0	0	0
C. greenei	3	11	4	0	2	0	2	1
C. viscidiflorus	33	60	21	10	3	0	9	1
C. humilis	4	7	5	6	1	0	0	1
PULCHELLI								
C. vaseyi	3	7	4	0	1	0	3	0
C. molestus	2	2	0	0	0	0	0	0
C. depressus	4	7	3	1	2	0	1	0
C. pulchellus	9	10	2	0	1	0	1	0
PUNCTATI								
C. teretifolius	3	4	1	1	0	0	0	0
C. paniculatus	3	5	0	0	0	0	0	0
All taxa	170	292	74	24	20	7	29	12

REVISION OF SECTION SUFFRUTICOSI OF THE GENUS SENECIO (COMPOSITAE)[1]

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This study includes the extra-tropical North American species of *Senecio* which are suffruticose perennials; glabrous to woolly tomentose; with several to many stems arising from a tap-rooted woody caudex; with leaves simple, linear to linear-filiform, or pinnately divided into linear or linear-filiform segments. These plants are believed to constitute a natural assemblage of species and are here termed the *Suffruticosi*.

Present use of the term *Suffruticosi* approximates that given formal taxonomic status by Greenman (1901) and called section *Longilobi* by Rydberg (1917). It is used here, however, purely as a convenience and does not imply formal taxonomic acceptance. The whole complex of ligneous and subligneous *Senecios* must receive critical attention before the sectional lines are formally defined.

A total of seventeen species were recognized by Greenman in his treatment (1901). Of these, only the following five are included in the present study: *S. douglasii* DC., *S. filicifolius* Greenm., *S. filifolius* Nutt., *S. multicapitatus* Greenm., and *S. spartioides* Torr. & Gray. Other species which have been included in the *Suffruticosi* at one time or another due to the ligneous condition of their stem, but have not been included in the present study are: *S. alvarezensis* Greenm., *S. calcarius* HBK., *S. carnerensis* Greenm., *S. cedrosensis* Greene, *S. chrysactis* Schultz Bip., *S. cinerarioides* HBK., *S. flaccidus* Less., *S. lemmoni* A. Gray, *S. lyonii* A. Gray, *S. marietanus* DC., *S. peninsularis* Vasey & Rose, *S. picridis* Schauer, *S. procumbens* HBK., *S. stoechadiformis* DC., and *S. teliformis* Greenm. Most of these excluded species form a large complex in the Andes and the mountains of Central Mexico. Exceptions to this are *S. lyonii* and *S. cedrosensis* which occur on the islands off the coast of California and Baja California but do not appear to be a part of this natural assemblage.

Senecio lemmoni, although a temperate North American species, is morphologically so unlike the group that it also is excluded.

The *Suffruticosi* complex, as presently recognized, ranges throughout the

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Southwest, east from California through the Great Plains region to about the ninety-seventh meridian, and from near the Canadian border southward into Mexico.

Historical Account

The *Suffruticosi* complex was first treated by De Candolle (1837) and later by Gray (1884) in his Synoptical Flora of North America. Greenman (1901) listed the species he considered to belong to this group, but no complete study was directed solely toward them.

In undertaking this study it was hoped that much of the taxonomic confusion in this section could be eliminated. In attempting to identify initial collections it was noted that names often followed state boundaries instead of population boundaries. For example *S. douglasii* keys to *S. longilobus* in Colorado (Harrington, 1954), to *S. filifolius* in New Mexico (Wooton and Standley, 1915), and to *S. douglasii* in California (Abrams, 1960).

There is also disagreement as to the taxonomic rank to use for different entities. *Senecio riddellii* Torr. & Gray, for example, is treated as a species by some writers and as a variety by others.

A total of forty-nine names have been used for the *Suffruticosi* as here conceived. In this study only five species and two varieties are given taxonomic acceptance.

Characters of Taxonomic Significance

Pubescence. Plants in the *Suffruticosi* range in pubescence from glabrous to woolly tomentose. In three species lack of pubescence seems to be a stable character. *Senecio riddellii* was grown in the Kansas State University greenhouse as well as in an experimental plot at Manhattan, Kansas, and remained glabrous during its entire life cycle under these conditions. This was not true for *S. douglasii* (Figs. 1-4). Seeds from a woolly tomentose parent grew into plants showing varying degrees of pubescence.

Perennating Organs. A woody, erect caudex with a large taproot is the common condition found in this complex.

Leaves. The lobing patterns of the leaves offer taxonomic characters for separating *S. riddellii* and *S. multicapitatus* from *S. spartioides.* In *S. douglasii*, however, this character proves to be too variable for taxonomic significance. In collecting material in the field it was noticed that individuals would range from forms with entire leaves to forms with pinnatifid leaves with an integrading series of intermediate forms. For example, the collection *Barkley, Ediger, & Lackey 380* has both entire and pinnatifid leaves. Some plants grown from seed of this collection have entire leaves, some have pinnatifid leaves, and some have a combination of both.

Another factor of some taxonomic importance in separating the two varieties of *S. douglasii* is the fascicles of leaves which often occur in the leaf axils of *S. douglasii* var. *longilobus*. These fascicles are short branchlets with whorls of smaller leaves growing in the axils of the primary leaves along the main stems of the plant.

Inflorescence. The inflorescence is composed of several to many heads arranged in a corymbose cyme. The number of involucral bracts present, although not constant, provides a significant character for separating taxa. As reported by Barkley (1960, 1962, 1968) in other groups of *Senecio*, the involucral bracts tend to be present in numbers corresponding to the Fibonacci series (1, 1, 2, 3, 5, 8, 13, 21 . . . .).

Another significant feature is the calyculate involucre, and the length of these outer bracteoles compared to the length of the major involucral bracts.

Although the number of ray florets may be significant for taxonomic purposes, they are often missing from herbarium material and are frequently lost from maturing plants, so they are not a convenient character.

The color of the rays (yellow) and the canescent condition of the achenes do not show enough variation to be significant.

Habitat. The habitat in which this group of *Senecio* can be found is relatively uniform throughout its range. After several extended collecting trips and from data on specimens it is evident that these plants grow primarily in dry, sandy, or rocky, disturbed areas. Roadcuts and dry stream washes are the normal habitats.

The soil is generally gravelly or rocky and seldom will support much other vegetation within close proximity to a *Senecio* shrub. Along roadsides the plants will often be found on steep slopes or the shoulder gravel. If other vegetation invades, the *Senecio* soon disappears. In an experimental plot at Manhattan, Kansas, plants thrived as long as other vegetation was excluded. When the plot was allowed to return to its natural condition, the *Senecio* plants were soon choked out.

Biology of the Group

The chromosome numbers found in the *Suffruticosi* follow the pattern described by Afzelius (1925, 1949) and discussed by Barkley (1962). Table 1 is a list of the chromosome counts which are known from published accounts or from voucher collections which have been seen. The names of the voucher specimens are grouped under the entity to which they have been referred in the text of this paper.

In all cases counts of n=20 are reported. Therefore chromosome number is not of diagnostic importance in delimiting species in this group.

During the summer of 1965 seeds were collected from Oklahoma, New Mexico, Texas, and Arizona. In the fall these seeds were planted in the greenhouse. After the plants were large enough to handle they were individually potted. In the spring of 1966 duplicates of these plantings were transferred to an experimental plot below Tuttle Creek Dam, 6 miles north of Manhattan, Kansas. The plants were allowed to remain there for two years with comparisons made between those in the experimental plot, those left in the greenhouse, and the specimens of parental material from which the seeds were obtained.

Due to the semi-weedy nature of this group, taxonomic characters in several cases proved to be quite variable. One example of the range of variation

found to exist in these plants is shown in Figs. 1-4. In this instance seeds from a densely white-tomentose parent plant with mostly short entire leaves and numerous fascicles of leaves in the leaf axils produced both glabrous and tomentose plants. There was also extensive variation in the leaves, ranging from long entire leaves on some plants to pinnatifid leaves on other plants. There were also plants that lacked fascicles of leaves in the axils while other plants exhibited this condition. Plants from other collections grown under these conditions also produced extensive variation. Plantings of *S. riddellii*, however, retained their characteristic morphology under these experimental conditions.

Further experimental studies are required to significantly quantify the data and bring a more meaningful understanding to the apparently complex genecology of the group.

Taxonomic Concepts

The species concept employed in this study is based on morphological variation and geographical distribution. Several species intergrade with each other at their boundaries, thus almost eliminating morphological gaps in variation which should theoretically exist for separation of taxa. Admittedly this is not a perfect concept of species, but to insist on complete separation by morphological gaps in variation would create a huge species complex, distinct in different regions of its range but held together by a few morphological intermediates.

Varieties are the only intraspecific taxa recognized in this study. They are based on less consistent morphological variation and on geographic distribution. This is in accord with the species concept used by Barkley (1960, 1962, 1968) for other similar behaving groups of *Senecio*.

Sources of Data

This revision is based on field work, herbarium studies, experimental studies, and the pertinent literature.

Over 5,000 herbarium specimens have been studied and annotated. Specimens were kindly lent by the following institutions: A, ARIZ, DS, F, GH, JEPS, KSC, MICH, MO, NY, PH, SMU, TEX, UC, US, UTC. The symbols used in the citations of specimens are in accord with the Lanjouw and Stafleu, Index Herbariorum, part I (1964).

Distribution Maps

The distribution maps were made by plotting the collection localities of the herbarium specimens brought together at Kansas State University for this study. In general one dot represents a single collection. In areas of repeated collecting, however, one dot represents several collections from the same locality.

The purpose of the distribution maps is to show graphically the distribution and geographical range of the different entities. Since certain areas are more accessible than others, a false representation as to areas of heavy concentration of certain taxa is evident.

Due to the poisonous nature of some species to livestock, they may be completely missing from areas which they formerly inhabited because of intentional eradication programs. This is especially true for *S. riddellii* which is currently rather rare in Kansas, although the distribution map would tend to indicate it to be abundant in the western half of the state. Most of these collections were made sixty or more years ago.

The numbers of the maps correspond to the numbers of the various taxa in the text.

KEY TO SPECIES

1. Plants subtomentose to woolly tomentose. . . . . 1. *S. douglasii*
1. Plants glabrous or with minute amounts of tomentum in the leaf axils and among the heads in the inflorescence.
   2. Heads calyculate with at least some bracteoles one-half the length of the involucral bracts. . . . . 1. *S. douglasii*
   2. Heads lacking bracteoles, or if bracteoles present, all less than a fourth the length of the involucral bracts.
      3. Heads small, narrowly campanulate or subcylindrical; disks 3-6 mm wide, rarely wider in pressed specimens; involucral bracts (7) 8 (13).
         4. Leaves mostly pinnately divided into narrowly linear-filiform segments seldom exceeding 1 mm in width. . . . . 2. *S. multicapitatus*
         4. Leaves mostly simple, linear with at least some 2 mm or more wide. . . . . 3. *S. spartioides*
      3. Heads large, campanulate; disks 7-12 mm wide in pressed specimens; number of involucral bracts (8) 13 (17).
         5. Leaves linear-pinnatilobate; plants of the Great Plains and hills of central and south central United States. . . . . 4. *S. riddellii*
         5. Leaves linear-entire; plants of the central coastal area of California. . . . . 5. *S. blochmanae*

1. SENECIO DOUGLASII DC.

Suffruticose perennial 0.3 - 2.0 m tall, glabrous to white-tomentose; stems erect, several to many, branching from an almost herbaceous to a woody taprooted caudex. Leaves narrowly linear, few to numerous and extremely variable: all entire, all pinnatifid, or all stages in between, generally with a few lateral segments. Principal leaves of tomentose forms often with fascicles of somewhat smaller leaves, or short leafy branches in the axils of the lateral branches. Fascicles of leaves rare in glabrous forms to abundant in some tomentose specimens. Inflorescence terminating the stems in a corymbose cyme of several to numerous heads; heads campanulate (6) 8-12 (15) mm wide at the top of the involucral bracts tapering to (3) 4-6 (7) mm in width at the base of the involucral bracts; principal involucral bracts 13-21 in number (6) 7-10 (14) mm long, bracteoles few to many from less than a

fourth to three-fourths the length of the principal bracts; rays yellow; achenes canous-hirtellous.

Dry, sandy, rocky soils, creek bottoms, and disturbed areas throughout the dry valleys and plains of the southwestern U.S. and northern Mexico.

Senecio douglasii is the most diversified species in this group, having a great number of geographic and ecological variants, many of which have been given taxonomic recognition in the past. Several of these names correspond more closely to state lines than to population boundaries. Present breeding experiments indicate that a complete examination of phenotypic expression of this species would be most valuable.

Various phases of this species have been well known under the names *S. longilobus*, *S. monoensis*, *S. filifolius*, and in nomenclatural combinations of these names. Two varieties are recognized in the present study.

Key to Varieties of *Senecio douglasii*

1. Plants mostly glabrous or subtomentose, becoming tomentose in their southeastern range of the U.S. and Mexico; heads large, mostly 10 mm wide or wider; bracteoles conspicuous, some at least one-half the length of the involucral bracts or longer. . . . 1a. *S. douglasii* var. *douglasii*
1. Plants mostly white-tomentose, few being subtomentose; heads about 10 mm or less in width; bracteoles absent or few in number, less than one-half the length of the involucral bracts. . 1b. *S. douglasii* var. *longilobus*

1a. SENECIO DOUGLASII DC. var. DOUGLASII

Senecio douglasii DC., Prodr. 6:429. 1837. Type Coll.: *Douglas*, California, 1833. (GH — isotype)

Senecio monoensis Greene, Leaflets Bot. Obs. & Crit. 1906. *S. douglasii* var. *monoensis* (Greene) Jepson, Man. F. Pl. Calif. 1149. 1925. Type Coll.: *Heller 8330*, White Mountains of Mono Co., California, on slate hills near Southern Belle Mine, 25 May 1906. (US — holotype; DS, F, GH, MO, NY, PH, UC).

Senecio lathyroides Greene, Leaflets Bot. Obs. & Crit. 1909. Type Coll.: *Jones 5077*, Pierce's Spring, Arizona, 18 Apr 1894. (US — holotype; NY).

Senecio filicifolius Greenm., Ann. Mo. Bot. Gard. 1:274. 1914. Type Coll.: *Pringle 316*, Valley of the Santa Cruz River, 11 May 1881. (Reputedly at GH but not seen.)

Senecio pectinatus A. Nels., Univ. Wyoming Pub. Bot. 1:141. 1926. Type Coll.: *Hanson 1020*. In washes. Infrequent. Near Baboquivari Mts, Arizona, 24 Feb 1923. (Photograph & fragments US — holotype; F, MO, PH, US).

Senecio douglasii var. *tularensis* Munz, Aliso 4:99. 1958. Type Coll.: *Munz 12222*, Dry slopes of disintegrated granite under oaks, road from Springville to Camp Nelson. Sequoia National Forest, Tulare County, California, 12 Oct 1947. (NY — isotype).

Senecio warnockii Shinners, Sida 1:379. 1964. Type Coll.: *Turner & Warnock 202*, Frequent on gypseous soil; 40 miles north of Van Horn, Texas, alt. 4000 ft., 16 Sep 1948. (SMU — holotype; MICH.)

Plants suffruticose to almost herbaceous, glabrous to subtomentose; leaves

few, mostly pinnatifid; heads large, mostly over 10 mm in width; bracteoles conspicuous, at least some over one-half the length of the involucral bracts.

Rocky or sandy soils on the slopes of mountains from near sea level to 5,500 feet. Ranging from the fortieth parallel in California south into Baja California and Sonora, Mexico. Also found in the southern tip of Nevada, southwestern corner of Utah, throughout Arizona with several collections in New Mexico and western Texas.

Representative material.[2] ARIZONA. Cochise Co.: *Ediger 535* (KSC). Coconino Co.: *Delzie Demaree 40955* (NY). Gila Co.: *Rose E. Collom 99* (GH, MICH, MO, NY, US). Graham Co.: *Maguire, Richards & Moeller 10164* (GH, US, UTC). Mohave Co.: *Gould & Darrow 4299* (ARIZ, GH, NY, UC). Pima Co.: *Frank W. Gould 3063* (ARIZ, DS, F, GH, MO, NY, UC, US, UTC). Yavapai Co.: *Barkley & Burroughs 288* (KSC). CALIFORNIA. Fresno Co.: *H. M. Hall 10035* (DS, MO, UC, US). Inyo Co.: *Victor Duran 598* (ARIZ, DS, F, GH, MICH, MO, NY, UC, US, UTC). Kern Co.: *Ediger 527* (KSC) and *528* (KSC). Los Angeles Co.: *Barkley & Burroughs 293* (KSC). Mendocino-Sonoma Co. line: *Barkley & Burroughs 302* (KSC). Monterey Co.: *Wiggins & Ferris 9012* (DS, GH, NY, UC, UTC). Riverside Co.: *Ediger 531* (KSC). San Bernardino Co.: *Leroy Abrams 2690* (DS, F, GH, MO, NY, PH). San Diego Co.: *Ediger 533* (KSC). San Luis Obispo Co.: *Ediger 529* (KSC). Santa Barbara Co.: *Ediger 530* (KSC). NEVADA. Clark Co.: *I. W. Clokey 8181* (ARIZ, DS, F, KSC, MICH, MO, NY, PH, SMU, TEX, UC, UTC). NEW MEXICO. Grant Co.: *John W. Gillespie 5317* (DS, GH, UC, US). Guadalupe Co.: *Aven Nelson 11321* (DS, GH, NY). Sierra Co.: *O. B. Metcalfe 971* (GH, MO, NY, PH, UC, US). UTAH. Washington Co.: *Frank W. Gould 1787* (ARIZ, DS, F, GH, NY, PH, UC, US).—MEXICO. BAJA CALIFORNIA: *Wiggins & Gillespie 4162* (DS, MICH, MO, NY, US). SONORA: *Roxana S. Ferris 8767* (DS, MICH, NY, US).

Senecio douglasii var. *douglasii* encompasses several different phases. Plants east of the Sierra Nevada Mountains in the White, Inyo, and Panamint mountain ranges of California and south into Baja California and Sonora, Mexico, are glabrous and appear more herbaceous than the other phases. Plants from these locations often die completely back to the ground each year. The glabrous phase also occurs on the east side of the Spring Mountains in Clark County, Nevada, the south-western corner of Utah, and in the mountainous areas of central Arizona, mainly in a zone running from the northwest corner to the southeast corner of the state. There have also been a few scattered collections in New Mexico and Texas. This phase has been treated as a distinct entity under the name *S. monoensis* Greene, and as a variety of *S. douglasii* DC. by Jepson (1925). Figure 6 illustrates the general morphology of this phase.

A second phase of this variety occurs west of the Sierra Nevada Mountains and along the coast south of San Francisco in California. In contrast to the first phase, the second phase exhibits a subtomentose condition, the tomen-

[2] A complete list of annotated specimens and an index to exsiccatae are in the dissertation on file at the Kansas State University Library.

tum increasing markedly toward the eastern limits of the range. The foliage is usually denser and may contain fascicles of smaller leaves in the primary leaf axils. The subtomentose plants also tend to be more woody.

The range for the subtomentose phase spreads eastward through Arizona becoming less common in New Mexico and Texas with only a few collections in Mexico and one in Utah.

Although the glabrous and subtomentose phases are represented by highly distinctive specimens, a complete series of intermediates exists between these forms and these phases lack any distinctive populational integrity of their own. Therefore, it is better to regard them as a single variable group than to attempt to separate them on superficial characters which do not remain constant under experimental conditions and which lack populational constancy in the field.

Most of the names which have been applied to this taxon represent extremes in variability. After examining a large number of collections and with the results of experimental material grown in the greenhouse presented in "Biology of the Group" I am convinced that the interpretation offered here is the most logical for the group.

Senecio warnockii Shinners is described as being closely allied with *S. spartioides* on the basis of its entire leaves. However, its affinity seems to lie with *S. douglasii* with intermediates grading into the more typical forms of *S. douglasii*. It is probably an ecological phase restricted to gypseous soil.

In visiting with the operator of the Trading Post at Tsegi, Arizona, it was learned that *S. douglasii* has some importance in Navajo medicine and folklore.

1b. SENECIO DOUGLASII var. LONGILOBUS (Benth.) L. Benson, Amer. Journ. Bot. 30: 631. 1943.

Senecio filifolius var. *jamesii* T. & G., Fl. N. Am. 2: 444. 1843. (This was var. alpha, and *S. filifolius* Nutt. was given as synonym under this variety only. Hence the type is not the James collection used to amplify the description, but the type of *S. filifolius* Nutt. The epithet *jamesii* is therefore illegitimate under Art. 24 of the Code, since it includes the type of the next higher taxon.)

Senecio regiomontanus DC., Prodr. 6: 429. 1837. Type coll.: Mexico, circa Real del Monte, *Haenke* (not seen).

Senecio longilobus Benth., Pl. Hartw. 18. Type coll.: In arvis arenosis, Aguas Calientes, *Coulter 127* (not seen).

Senecio filifolius Nutt., Trans. Amer. Phil. Soc. n.s. 7: 414. 1841. Type coll.: banks of the Missouri towards the Rocky Mountains, *Nuttall* (photograph MO).

Senecio orthophyllus Greene, Leafl. Bot. Obs. & Crit. 1: 221. 1906. Type coll.: Willow Springs, Arizona, *Palmer 479*, in 1890 (US — holotype; photograph MO).

Plants suffruticose, tomentose; leaves few to many, entire to pinnatifid, often with fascicles of somewhat smaller leaves or short leafy branches in

the axils; heads mostly 10 mm. or less in width; bracteoles absent or few in number, less than ½ the length of the involucral bracts.

Throughout New Mexico and western Texas, with fewer collections from the panhandle of Oklahoma, southern Colorado, southern Utah, northern and eastern Arizona, and above the 20th Parallel in Mexico.

Representative material. ARIZONA. Apache Co.: *Ediger 513* (KSC). Cochise Co.: *Leslie N. Goodding 2252* (DS, GH, MO, NY, UC). Coconino Co.: *Ediger 520* (KSC). Navajo Co.: *Ediger 518* (KSC). Pima Co.: *Ediger 534* (KSC). Yavapai Co.: *Ediger 526* (KSC). COLORADO. Fremont Co.: *Ediger 504* (KSC). LaPlata Co.: *Ediger 506* (KSC). Pueblo Co.: *Ediger 502* (KSC). NEW MEXICO. Bernalillo Co.: *A. A. Heller 15798* (DS, MO, NY, PH, US, UTC). Catron Co.: *Barkley, Ediger & Lackey 375* (KSC). Chaves Co.: *Ediger 539* (KSC). Dona Ana Co.: *E. O. Wooton,* May 1905 (ARIZ, DS, MICH, MO, PH, US). Lincoln Co.: *Barkley, Ediger & Lackey 364* (KSC). San Juan Co.: *Ediger 507* (KSC). San Miguel Co.: *Paul C. Standley 4993* (GH, MO, NY, US). Taos Co.: *Barkley, Ediger & Lackey 357* (KSC). OKLAHOMA. Cimarron Co.: *Delzie Demaree 13367* (NY, SMU). TEXAS. Crane Co.: *Jim Lackey 3* (KSC). El Paso Co.: *Ediger 536* (KSC). Jeff Davis Co.: *Ferris & Duncan 2717* (DS, MO, NY). Lubbock Co.: *Demaree 7602* (DS, GH, MO, SMU, US). Pecos Co.: *Barton H. Warnock 46141* (F, MO, TEX). UTAH. Iron Co.: *Loran C. Anderson 900* (KSC). San Juan Co.: *Cronquist & Holmgren 9380* (NY, SMU, TEX, UTC). Wayne Co.: *Marcus E. Jones 5703* (MO, NY, UC, US).—MEXICO. CHIHUAHUA: *J. M. Tucker 2477* (ARIZ, DS, UC, US). COAHUILA: *Wynd & Mueller 421* (ARIZ, MICH, MO, NY). San Luis Potosi: *J. G. Schaffner 713* (MICH, NY, US).

The gross morphology and distribution of *S. douglasii* var. *longilobus* combine to make it a distinct entity. The morphology of the heads is similar to that of *S. douglasii* var. *douglasii* except for shorter or absent bracteoles and the smaller head size. *Senecio douglasii* var. *longilobus* is subtomentose or tomentose and more eastern in its distribution. The transition zone from typical *S. douglasii* var. *douglasii* to *S. douglasii* var. *longilobus* is centered in Arizona and Sonora, Mexico, where morphological intermediates make it difficult to separate the two varieties.

The decision to group so many variants into one species with only two varieties was strengthened by the experimental plantings carried out at Kansas State University from 1965-1967. The details of this experimental study are presented above.

2. SENECIO MULTICAPITATUS Greenm.

Senecio multicapitatus Greenm., Bull. Torrey Bot. Club 33:160. 1906. Type Coll.: *Vreeland 651*, Huerfano Valley near Gardner, Colo., 1900. (NY — lectotype).

Suffruticose perennial 30-130 cm tall, glabrous; stems several to many branching from a stout, woody, erect, taprooted caudex. Leaves irregularly pinnately divided into linear-filiform segments 1-2 (5) mm wide and (4) 5-7 (10)cm long, the lower leaves sometimes wider and with only small lobes,

grading into entire leaves without lobes. Inflorescence a terminal corymbose cyme of many heads; heads sub-cylindrical to narrowly campanulate, 2 mm wide at the base of the involucral bracts, spreading to 3-5 mm wide at the top of the involucral bracts in dried specimens. In nature the heads are often quite turbinate or even narrowing upwards. Principal bracts approximately 8 in number, 7-9 mm long, bracteoles, if present, few in number and less than a fourth as long as the principal bracts; rays yellow, usually persisting at maturity. Achenes canous-hirtellous.

Sandy, dry soils especially in old washes and hillsides at elevations of 5,000 to 9,000 feet. From the eastern edge of the Rocky Mountains westward throughout the middle elevations in Colorado, New Mexico, Arizona, and southern Utah. Apparently occasional in the mountainous areas of western Texas and Mexico, south of New Mexico.

Representative material. ARIZONA. Coconino Co.: *Gould & Phillips 4762* (ARIZ, TEX, UC). Navajo Co.: *H. H. Rusby 667* (MICH, NY). COLORADO. Alamosa Co.: *U. T. Waterfall 12198* (TEX). Costilla Co.: *Anderson & Barkley 2468* (KSC, NY). El Paso Co.: *J. H. Ehlers 7938* (ARIZ, MICH). Montrose Co.: *Edwin Payson 607* (DS, F, GH, MO). Rio Grande Co.: *Anderson & Barkley 2525* (KSC). NEW MEXICO. Colfax Co.: *Rose & Fitch 17544* (MO, NY, US). Dona Ana Co.: *E. O. Wooton* Oct. 20, 1903 (ARIZ, MICH, MO, NY, UC). Lincoln Co.: *F. S. & Esther Earle 388* (MO, NY, US). San Miguel Co.: *Drouet & Richards 3190* (F, MICH, MO, NY). Santa Fe Co.: *Rose & Fitch 17690* (MO, NY, US). Taos Co.: *Barkley, Ediger & Lackey 355* (KSC). TEXAS. Brewster Co.: *Omer E. Sperry T652* (ARIZ, GH, UC). UTAH. Garfield Co.: *C. D. Marsh 14089* (US). San Juan Co.: *H. C. Cutler 3084* (DS, F, MO, NY, SMU). Uintah Co.: *Edward H. Graham 7455* (UC).—MEXICO. CHIHUAHUA: *Harde LeSueur 332* (ARIZ, F, UC).

Senecio multicapitatus is characterized by its glabrous condition, pinnately branched leaves, and its many small heads. *Senecio multicapitatus* is distinct within its own range but intergrades with *S. riddellii* at the eastern edge of the Rocky Mountains as is discussed under *S. riddellii*, and with *S. spartioides* as is discussed under that taxon.

A voucher for studies on the Navajo Indians by Washington Matthews (UC) lists the Indian name for this species as *gos bel Se hi.*

The type collection is a mixed complex of specimens from several states. To facilitate handling of nomenclature I have designated the specimen *F. K. Vreeland 651* (NY) as the lectotype.

3. SENECIO SPARTIOIDES Torr. & Gray

Senecio spartioides Torr. & Gray, Fl. N. Amer. 2:438. 1842. Type Coll.: *Lieut. Fremont,* Sand-bank of the Sweetwater River (Wyoming), Aug.-Sept. (NY — holotype; GH).

Senecio serra var. *sanctus* Hall, Univ. Calif. Pub. Bot. 3:230. 1907. Type Coll.: *Hall 7610,* South Fork Santa Ana River, San Bernardino Mts., Calif., Along the lower edge of the Canadian Zone at 2000 M alt., 1 Aug 1906. (UC — holotype).

Senecio andersonii Clokey, Bull. S. Calif. Acad. Sci. 37:10. 1938. Type Coll.: *Clokey & Anderson 5638*, Lee Canyon in the yellow pine belt at an elevation of 2,550 M Nevada, 5 Aug 1935. (UC — holotype; ARIZ, DS, F, JEPS, MICH, MO, NY, TEX, UC, US).

S. spartioides var. *granularis* Maguire & Holmgren ex Cronquist in Ferris. Contrib. Dudley Herb. 5:102. 1958. Type Coll.: *Maguire & Holmgren 26066*, Head of Crooked Creek, White Mountains, Mono County, Calif. (NY — holotype; US, UTC).

Suffruticose perennial, 20-80 cm tall, glabrous; stems erect, numerous, branching from an erect taprooted caudex. Leaves narrowly linear and entire, rarely having a pair of short lobes at the base, usually at least a few over 1 mm wide, (3) 5-10 (12) cm long, evenly distributed up the stem. Inflorescence a corymbose cyme of many heads; heads subcylindrical to narrowly campanulate mostly 2 mm at the base of the involucral bracts spreading to (3) 4-6 (10) mm at the top of the involucral bracts. Principal bracts (7) 8-12 (13) in number and (3) 6-9 (10) mm long; bracteoles, if present, few in number and less than a fourth as long as the principal bracts; rays yellow; achenes canous-hirtellous.

Dry, sandy hillsides, plains, and disturbed areas mostly above 6,000 feet and up to 10,000 feet in the mountains of Colorado, Utah, southern Nevada, eastern and southern California, and the northern half of Arizona. Less frequent in New Mexico, Wyoming, and the extreme western edge of Nebraska and South Dakota. A few collections are from Baja California, but its distribution there is yet poorly known.

Representative material. ARIZONA. Coconino Co.: *D. T. MacDougal 352* (ARIZ, F, GH, NY, PH, UC, US). Mohave Co.: *Kearney & Peebles 12685* (ARIZ, F). Navajo Co.: *H. H. Rusby 670* (F, NY, PH, UC). CALIFORNIA. Inyo Co.: *Ross & Ross 5990* (DS, NY, UC). Mono Co.: *J. T. Howell 27462* (DS, SMU, UC, US). COLORADO. Boulder Co.: *Ewan & Ewan* 26 Sept. 1937 (ARIZ, DS, F, GH, MICH, MO, NY, PH, SMU, TEX, UC, US, UTC). Chaffee Co.: *I. W. Clokey 3496* (DS, F, GH, MICH, MO, NY, TEX, UC, US). Clear Creek Co.: *H. N. Patterson 240* (F, GH, MICH, MO, NY, PH, UC, US). El Paso Co.: *J. H. Ehlers 7937* (MICH, UTC). Gunnison Co.: *Barkley, Ediger & Lackey 395* (KSC). Larimer Co.: *Otto Degener 1504* (NY). Weld Co.: *E. L. Johnston 328b* (GH, NY). NEVADA. Clark Co.: *I. W. Clokey 7411* (DS, NY, UC). Lyon Co.: *Alexander & Kel'ogg 5317* (ARIZ, DS, SMU, UC, UTC). NEW MEXICO. Rio Arriba Co.: *C. F. Baker 715* (F, GH, MO, NY, US). UTAH. Garfield Co.: *Holmgren, Reveal & LaFrance 2463* (NY, TEX). Kane Co.: *Loran C. Anderson 916* (NY, UTC). Washington Co.: *Bassett Maguire 13940* (UTC). WYOMING. Albany Co.: *Aven Nelson 9556* (GH, MICH, MO, NY, US, UTC). Laramie Co.: *Aven Nelson 2726* (F, KSC).—MEXICO. Baja CALIFORNIA: *Wiggins & Demaree 4953* (DS, F, NY, UC, US).

Senecio spartioides is very closely related to *S. multicapitatus*, with the entire leaves of *S. spartioides* being the primary morphological difference separating the two. *Senecio spartioides* is more abundant in the southern and

eastern extent of its range. Although plants of both species can be found at elevations of 5,000—10,000 feet, *S. spartioides* is more frequent above 7,000 feet than is *S. multicapitatus*.

Senecio spartioides, *S. multicapitatus*, and *S. riddellii* intergrade at the eastern edge of the Rocky Mountains in Colorado producing putative hybrids which are extremely difficult to place since the characteristics of all three species may occur in a single specimen.

In the New York Botanical Garden are specimens labeled as hybrids between *S. spartioides* and *S. eremophilous* var. *kingii* (Rydb) Greenm. This collection is *Holmgren, Reveal & LaFrance 2463* from the Dixie National Forest of Utah, 14 Aug 1965. The ranges of these two populations overlap and hybridization is a distinct possibility, however the disparate placement of these two species in *Senecio* (Greenman, 1901) suggests that this would be a most noteworthy hybrid, warranting experimental investigation.

4. SENECIO RIDDELLII Torr. & Gray

Senecio riddellii Torr. & Gray, Fl. N. Amer. 2:444. 1843. *S. spartioides* var. *riddellii* (T. & G.) Greenm. Monogr. nord— & centralam. Art. Gattung *Senecio* pt. 1, 26. 1901. (Engl. Bot. Jahrb. 32:22. 1902). Type Coll.: *Dr. Riddell*, Texas. (Type reputedly at NY, not seen. Photograph MO, probable isotype US).

Senecio filifolius var. *fremontii* Torr. & Gray, Fl. N. Am. 2:444. 1843. *S. fremontii* Rydb., in Britton. Man. Fl. N. U.S. 1028. 1907. (not *S. fremontii* Torr. & Gray). Type Coll.: *Lieut. Fremont*, on the lower Platte, near the "chimney" Aug. - Sept. (NY — holotype; GH).

Senecio kuntzei Rydb., Fl. Rocky Mtns. & Adj. Plains. 990. 1917. Not *S. kuntzei* O. Hoffm. in Ktze., Rev. Gen. 3 (2):175. 1898. Type Coll.: *Kuntze 3033*, Colorado, Sept. 1874. (not seen).

Senecio spartioides var. *fremontii* Greenm. ex L. O. Williams, Ann. Mo. Bot. Gard. 23:456. 1936. Type Coll.: *Williams*, Sandy hills near Hat Creek, Niobrara Co., Wyoming, 6 Sep 1935. (MO — holotype).

Senecio riddellii var. *parksii* Cory, Rhodora, 45:164. 1943. *S. spartioides* var. *parksii* (Cory) Shinners, Sida, 1:379. 1964. Type Coll.: *Parks 27538*, Flour Bluff, Texas, 18 Oct 1936. (GH — holotype; NY, SMU).

Suffruticose perennial 30-100 cm tall, glabrous; stems erect, several to many branching from a stout woody, tap-rooted caudex. Leaves irregularly pinnately divided into linear-filiform segments 1-5 mm wide and 4-9 cm long generally appearing flat, those on the lower part of the stem often drying and pendulous on mature plants, foliage generally quite heavy. Inflorescence a corymbose cyme of 5-20 heads; heads campanulate, (5) 7-10 (12) mm wide at the top of the involucral bracts, tapering to 2-4 (5) mm at the base of the involucral bracts in pressed specimens; principal involucral bracts approximately 13 in number and 7-10 (12) mm in length, bracteoles less than a fourth as long as the principal bracts; rays yellow, often early deciduous; achenes canous-hirtellous.

Sandy soils, deposits along rivers or flood plains, and other sandy areas under dry conditions. Along the eastern edge of Wyoming, southwest corner of South Dakota, the Sand Hill region of Nebraska, eastern plains of Colorado to the Rocky Mountains, western half of Kansas, Oklahoma, and Texas. *Senecio riddellii* also occurs in the lower mountain ranges of New Mexico and central Arizona. A few collections are from northern Mexico.

Representative Material. ARIZONA. Navajo Co.: *Peebles & Fulton 9609* (ARIZ, US). COLORADO. Denver Co.: *I. W. Clokey 2945* (ARIZ, MO, NY, UC). Lincoln Co.: *Ivar Tidestrom 664* (US). Washington Co.: *William A. Weber 12952* (NY). KANSAS. Barber Co.: *R. L. McGregor 13762* (SMU, US). Clark Co.: *M. A. Carleton 742* (GH, KSC, MO, US). Ellis Co.: *Elam Bartholomew 1156* (NY). Hamilton Co.: *Rose & Fitch 17015* (NY, US). Sheridan Co.: *Clement Weber 158* (KSC). NEBRASKA. Cherry Co.: *W. L. Tolstead 762* (GH). Grant Co.: *P. A. Rydberg 1677* (GH, NY, US). Kimball Co.: *A. A. Heller 14304* (DS, F, MO). NEW MEXICO. Bernalillo Co.: *Arsene & Benedict 17511* (F, SMU, US). Chaves Co.: *U. T. Waterfall 5709* (GH, MO, NY, SMU). Lincoln Co.: *Earle & Earle 224* (MO, NY, UC, US). Santa Fe Co.: *Barkley, Ediger, & Lackey 358* (KSC). OKLAHOMA. Cleveland Co.: *George J. Goodman 2764* (GH, MO, NY, SMU, UC, US). Harmon Co.: *Lloyd H. Shinners 31655* (SMU). Texas Co.: *Lloyd C. Hulbert 4188* (KSC). Woods Co.: *G. W. Stevens 2826* (DS, GH, MO, NY, SMU, US). SOUTH DAKOTA. Custer Co.: *Jones & Jones 14473* (F). Shannon Co.: *S. S. Visher 2208* (F, NY). TEXAS. Brewster Co.: *B. H. Warnock 46672* (SMU, TEX). Jeff Davis Co.: *Loran C. Anderson 3036* (KSC). Lipscomb Co.: *Charles S. Wallis 7958* (SMU, TEX). Mustang Island: *Fred B. Jones 665* (SMU). Presidio Co.: *B. H. Warnock T169* (ARIZ, GH, TEX, US). WYOMING. Goshen Co.: *Porter & Porter 1948* (DS, US). Weston Co.: *Mildred E. Mathias 298* (GH, MO).

Senecio riddellii is characterized by its glabrous condition, pinnately divided leaves, and large heads. It is also the most easterly ranging species of this entire group.

Senecio riddellii is distinct within its own range but intergrades with *S. spartioides* and *S. multicapitatus* at the eastern edge of the Rocky Mountains, and in Arizona and New Mexico. This is illustrated by some of the basal leaves of *S. riddellii* becoming entire where the populations come together. The details and extent of this intergradation are yet to be elucidated.

Collections from Padre and Mustang Islands of Texas, along the Gulf of Mexico, show increased leaf width and greater head size than most of the other collections (Fig. 10). Representative collections of this population are *V. L. Cory 36658-36660* (GH). Occasional specimens from other locations throughout the range also exhibit these characteristics. I have not done field work on these islands, but this condition may be environmentally induced. Further field work must be done before the proper disposition of these plants can be determined. Until such time it seems best to consider them merely as an extreme in the total range of variability of the species.

5. SENECIO BLOCHMANAE Greene

Senecio blochmanae Greene, Erythea 1:7. 1893. Type Coll.: *Mrs. Blochman*, Santa Maria River, San Luis Obispo Co., California, Nov. 1892. (UC — holotype; NY).

Suffruticose perennial 45-130 cm tall, glabrous; stems woody and numerous, arising from a thickened base and apparently not dying back each year. Leaves entire, linear-filiform, 3-11 cm long, 1(+) mm wide, the lower ones drying and pendulous on mature plants, foliage abundant. Inflorescence a corymbose cyme of 5-20 heads; heads campanulate 7-9 (12) mm wide at the top of the involucral bracts in pressed specimens; principal involucral bracts approximately 13 in number, 7-10 mm long, bracteoles, if present, very few in number and usually less than a fourth as long as the principal bracts. Rays yellow; achenes canous-hirtellous.

Sand dunes and flood plains near the coast in Santa Barbara and San Luis Obispo Counties, California.

Representative Material. CALIFORNIA. San Luis Obispo Co.: *Delzie Demaree 18092* (DS, MO, NY, US). Santa Barbara Co.: *Annetta Carter 1330* (DS, GH, MICH, MO, NY, SMU, TEX, US, UTC).

Senecio blochmanae is characterized by its glabrous condition, entire leaves, and restricted distribution. The many leaves along the stem are thickened at the base, giving the stem a scaly appearance. The stems become purple-striated in age, often turning entirely purple, especially below.

Senecio blochmanae is distinct within its range and collections do not suggest any intergradation with any other *Senecio*.

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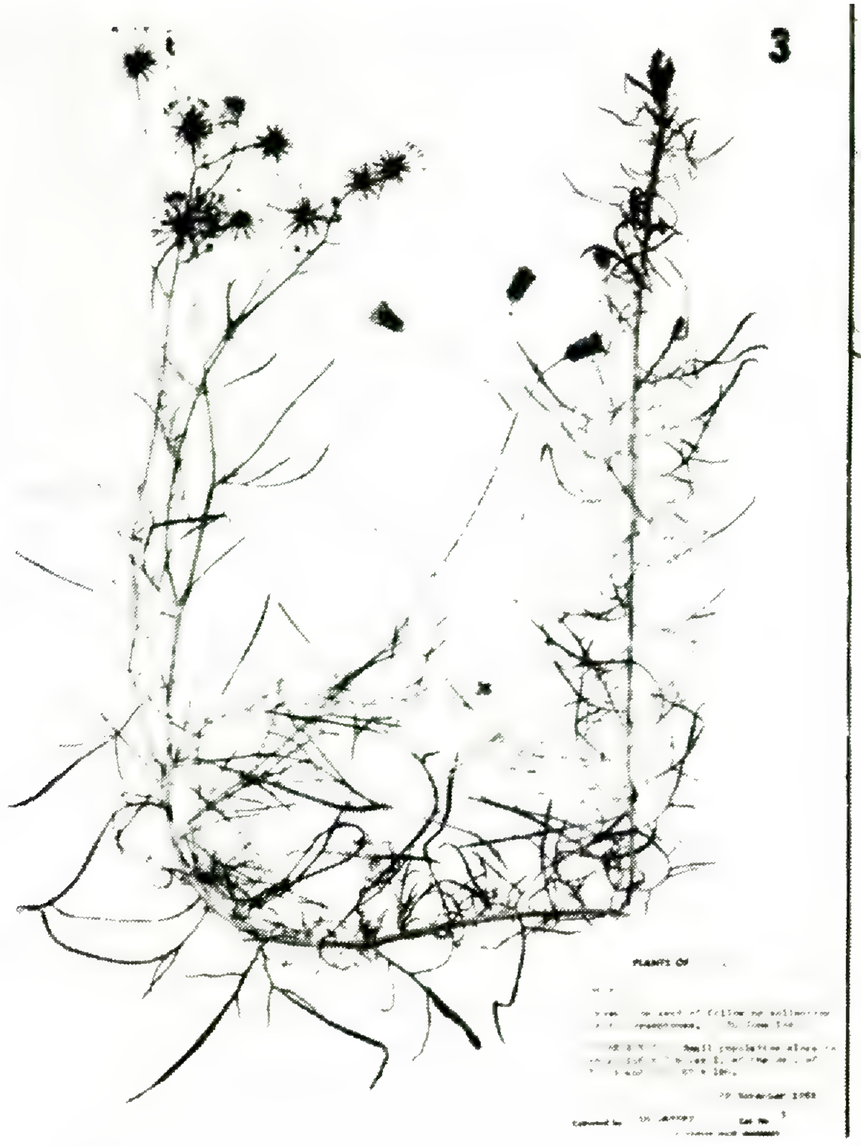
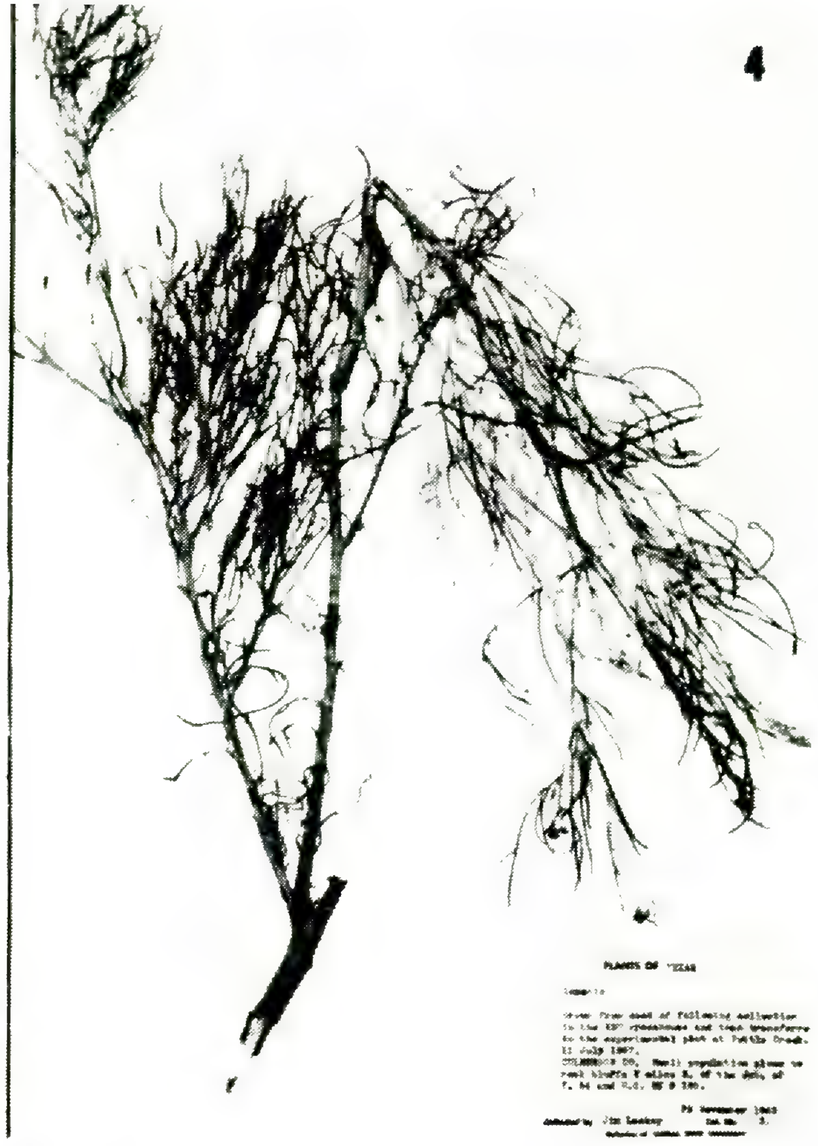
Figs. 1—4. Voucher specimens for experimental growth studies of *Senecio douglasii*. Fig. 1. Parent plant, *Jim Lackey 3*, from which seeds were collected for greenhouse plantings. Fig. 2. Specimen grown in the greenhouse from the above-mentioned plant, showing both long entire and small pinnately divided leaves.





Figs 1—4. Voucher specimens for experimental growth studies of *Senecio douglasii*. Fig. 3. Specimen grown from same parent plant as 2, having all pinnately divided leaves. Fig. 4. Plant from seed of the same parent plant as 2 and 3 but transferred to an experimental plot at Tuttle Creek Dam after one year in greenhouse. This specimen had several branches which were glabrous and others which were woolly-tomentose.

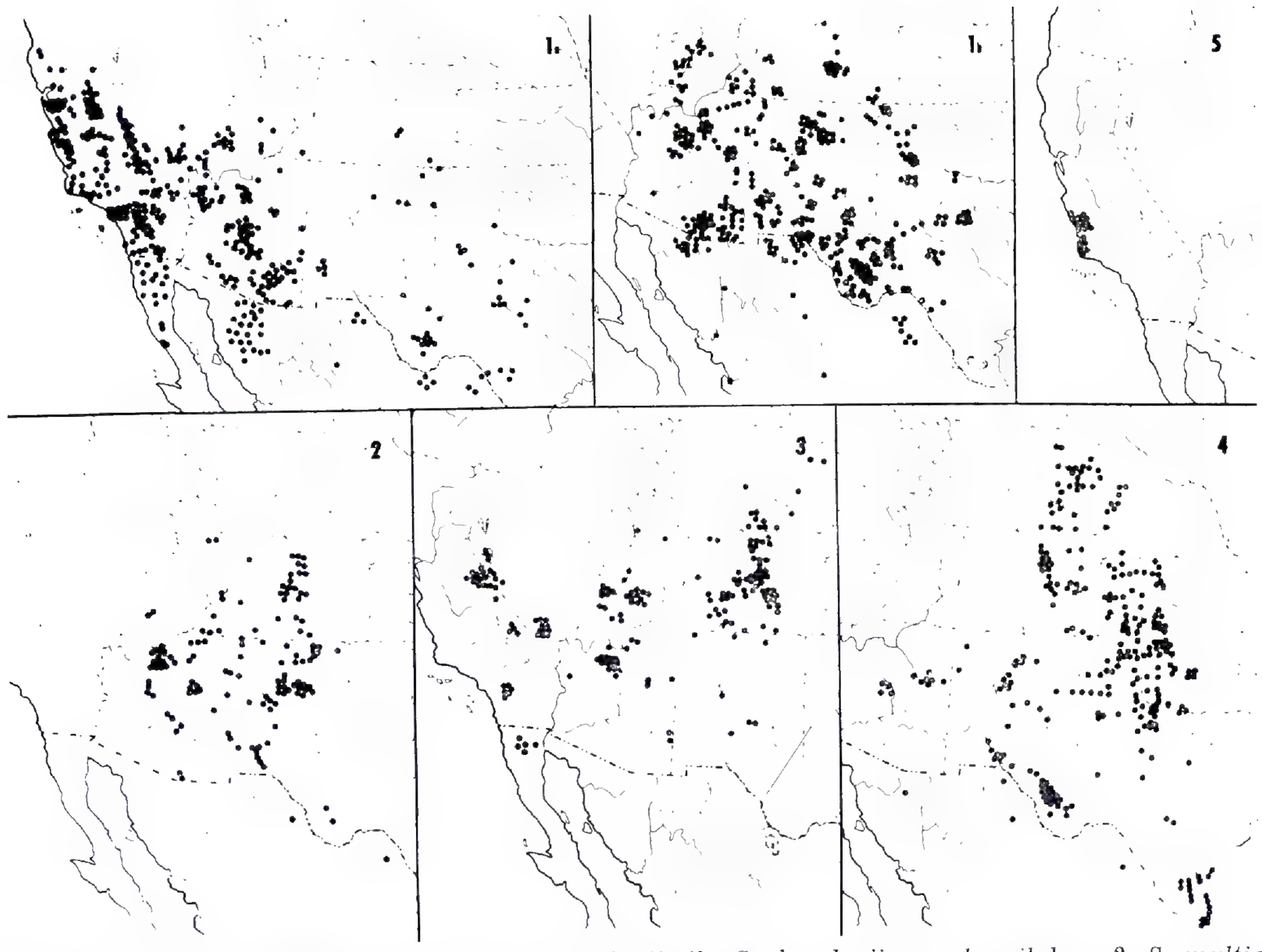


Fig. 5. Distribution of: 1a. *Senecio douglasii* var. *dogulasii*, 1b. *S. douglasii* var. *longilobus*. 2. *S. multicapitatus*. 3. *S. spartioides*. 4. *S. riddellii*. 5. *S. blochmanae*.

6

7a

7b

8

Figs. 6—8. Illustrations of: 6. *Senecio douglasii* var. *douglasii*. 7. *S. douglasii* var. *longilobus*, (a) woolly-tomentose plant with fascicles of leaves in many of the primary leaf axils, (b) a tomentose plant with fewer fascicles in the axils of the longer primary leaves. 8. *S. multicapitatus*.

9

10a

10b

11

Figs. 9—11. Illustrations of: 9. *Senecio spartioides*. 10. *S. riddellii*, (a) typical form, (b) form with greater head size and broader leaf divisions characteristic of collections from Padre and Mustang Islands, Texas. 11. *S. blochmanae*.

TABLE 1. CHROMOSOME COUNTS

Name	*Gametic Chromosome #*	*Location*	*Collector*	*Publication*
S. blochmanae	20	Santa Barbara Co., Calif.	Raven 15503	Ornduff et al. 1963
S. douglasii DC.	20	Riverside Co., Calif.	Kyhos 58-189	Ornduff et al. 1963
S. douglasii DC.	20	Los Angeles Co., Calif.	Mosquin C-19	Ornduff et al. 1963
S. douglasii DC.	20	Riverside Co., Calif.	Lewis 1249	Ornduff et al. 1963
S. douglasii DC.	20	Stanislaus Co., Calif.	Breedlove 4854	Ornduff et al. 1967
S. douglasii DC.	20	Ventura Co., Calif.	Breedlove 5576	Ornduff et al. 1967
S. douglasii var. *monoensis* (Greene) Jepson	20	Inyo Co., Calif.	Raven 12007	Ornduff et al. 1963
S. monoensis Greene	20	Yavapai Co., Arizona	Turner 4789	Powell 1963
S. pectinatus DC.	20	Mt. Kosciusko, Australia	Moore s.n.	Ornduff et al. 1963
S. douglasii var. *longilobus* (Benth.) L. Benson				
S. longilobus Benth.	20	Apache Co., New Mexico	Ornduff in 1957	Ornduff et al. 1967
S. longilobus Benth.	20	Rio Arriba Co., New Mexico	Mosquin 5744	Ornduff et al. 1967
S. longilobus Benth.	20	Jeff Davis Co., Texas	Mosquin 5658	Ornduff et al. 1967
S. longilobus Benth.	20	Bernalillo Co., New Mexico	Jackson 2037	Jackson 1959
S. multicapitatus Greenm.	20	Rio Arriba Co., New Mexico	Jackson 3119	———
S. spartioides Torr. & Gray	20	San Bernardino Co., Calif.	Raven 11165	Ornduff et al. 1963
S. spartioides Torr. & Gray	20	Coconino Co., Arizona	Solbrig 2799	Ornduff et al. 1963

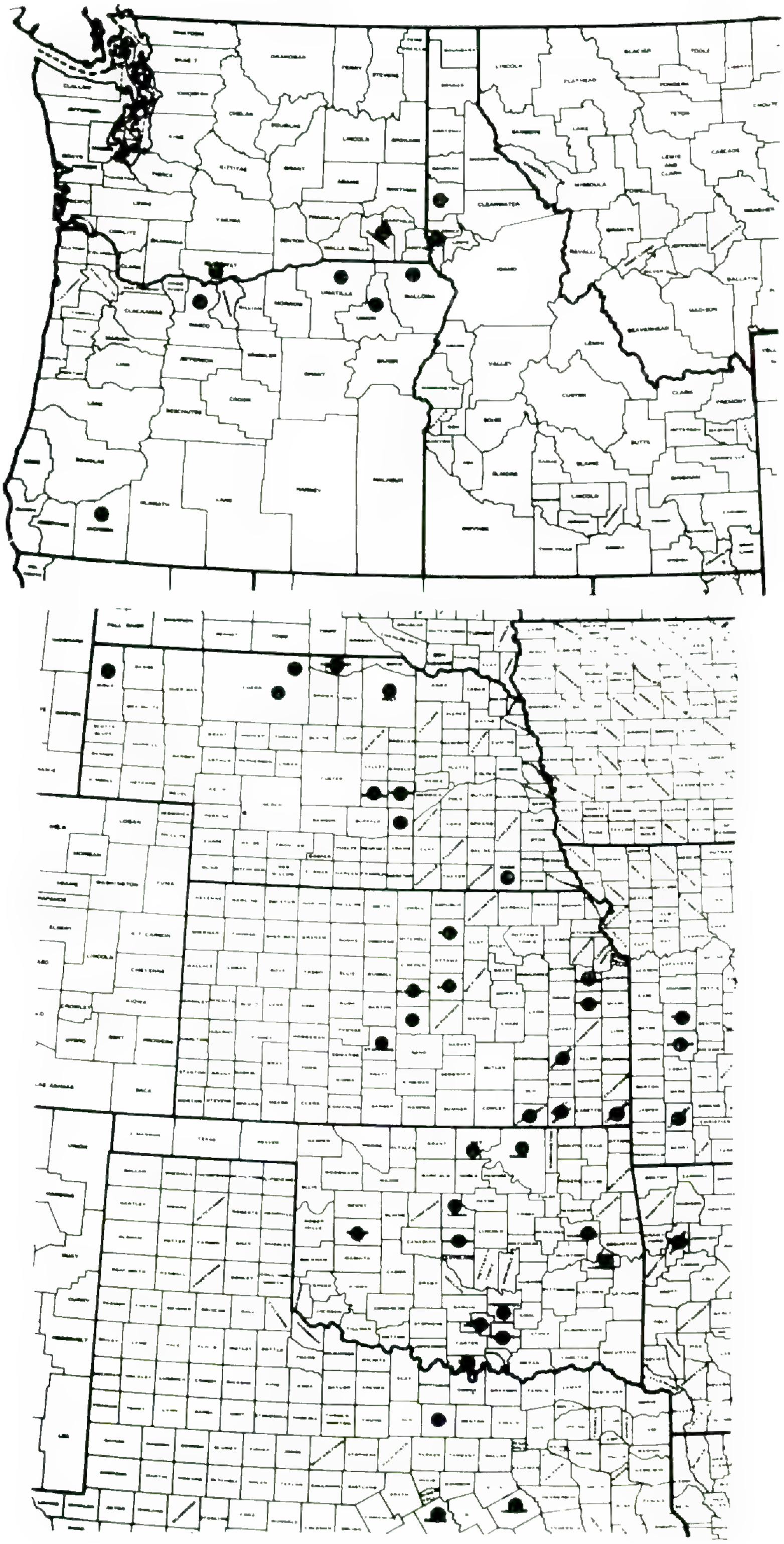
NOTES

PSILOTUM NUDUM (PSILOTACEAE) IN NORTH LOUISIANA.—On October 27, 1969, *Psilotum nudum* (L.) Griseb. was discovered approximately two miles west of Ruston, Lincoln Parish, Louisiana, on a taxonomy field trip under my direction. This noteworthy find was first observed by Ricky Owens, a member of the class who is a senior wildlife major at Louisiana Polytechnic Institute. It increases the known northern distribution of the plant in Louisiana by approximately 250 miles. Dr. William D. Reese has reported the species from Terrebonne Parish and St. Mary Parish (''Psilotum in Louisiana,'' Amer. Fern Journ. 50 (4): 269—270, 1960). Dr. John W. Thieret in a telephone conversation reported a collection from Vermilion Parish. It has been noted as a greenhouse adventive in Jefferson Parish and Lafayette Parish (Reese, l.c.; Clair A. Brown and Donovan S. Correll, *Ferns and Fern Allies of Louisiana*, 1942).

Nineteen specimens were counted in a ten yard area at the Ruston site. The plants were growing in sandy humus on the slope of a hill in immediate association with *Botrychium dissectum* var. *obliquum* within a forested area of *Liquidambar styraciflua, Sassafras albidum, Morus rubra* and *Castanea pumila*. The ecology is noteworthy in that the collecting site is much more upland than the typical bog where one might expect to find *Psilotum*. All specimens were sterile. Two specimens (*Rhodes & Owens 7766* and *7767*) were placed in the Louisiana Polytechnic Institute Herbarium.—*Donald G. Rhodes, Department of Botany and Bacteriology, Louisiana Polytechnic Institute, Ruston, Louisiana 71270.*

JUNCUS KANSANUS: A SYNONYM OF J. BRACHYPHYLLUS (JUNCACEAE).—Hermann (1935) first described *Juncus kansanus*, distinguishing it from the morphologically similar *J. brachyphyllus* Wieg. by its shorter auricles, narrower leaves, shorter more congested inflorescence, capsule shape, and degree of capsule concealment by the perianth. The description was based upon three specimens from eastern Kansas (Cloud Co.: Concordia, *Hitchcock*, June 17, 1897 [KSU, holotype]; Cloud Co.: *S. V. Fraser 68* [KSU, paratype]; Chautauqua Co.: *A. S. Hitchcock*, Aug. 8, 1896 [KSU, paratype]), and Steyermark (1963) later added Missouri to the known range.

In examining a number of more recent collections of *J. kansanus* from eastern Kansas I was able to assign all collections to *J. brachyphyllus*. The types of *J. kansanus* are overly ripe with shriveled auricles, and leaves narrowed by involution. Comparison of specimens exhibiting a range of maturation shows that narrowed leaves, shortened auricles, and degree of capsule concealment are dependent upon maturation, whereas the congestion of the inflorescence is variable. Consequently, there are no reasons for considering *J. kansanus* to be distinct from *J. brachyphyllus* and it should be treated as a synonym of the earlier described *J. brachyphyllus*. Hermann, himself, must have had later reservations as to the status of his species as a sheet in the Gray Herbarium (Kansas: Cloud Co.: 6½ mi. s. and 1 mi. w. of Aurora, n.



Distribution of *Juncus brachyphyllus*.

slope of rocky hillside, *S. V. Fraser 641*, Aug. 1, 1935 [G, KANU, KSU] bears his annotation label, "*J. brachyphyllus* Wiegand, var. *kansanus* (Hermann) Hermann, *comb. nov.*, ined. 8/35." However, no such nomenclatural change was published.

The range of specimens examined in this study is shown in the accompanying distribution map. I wish to thank the curators of the herbaria of GR, ID, KANU, KSU, NEB, OKLA, SMU, and WTU for their loan of material. Most authors treat *J. brachyphyllus* as a montane species but it is apparent that the bulk of the population occurs in a narrow band from the sandhills of north-central Nebraska, south to north-central Texas. From field observations and label information the species is restricted to sandy prairies or sandstone glades. The distributionally anomalous northwestern elements (Washington, Oregon, Idaho) are undoubtedly the source of montane habitat references. Collections of northwestern *J. brachyphyllus* are very scanty and only 10 sheets, including two duplicates were located.

Abrams (1955), Peck (1941), and Wooton and Standley (1915) include New Mexico in the range of *J. brachyphyllus* based upon Wiegand's (1900) citation of a paratype (Marcy's Expedition, between Moska and Red Fork, Arkansas, June-Sept., 1849, Herb. G. Thurber [G]), which Bartlett (1909) assigned to the general area of Santa Fe in New Mexico. From Bartlett's description of the route of Marcy's Expedition, the party traveled along the Arkansas River in Oklahoma which divides approximately 50 miles west of Ft. Smith into the Red Fork (now known as the Cimmaron) and Canadian Rivers. Since there are several modern collections from this area in Oklahoma and none from New Mexico, it is probable that the paratype labeled "red fork Arkansas," refers to the Red Fork of the Arkansas River in Oklahoma, not the Red Fork of the Rio Colorado in New Mexico as Bartlett believed.

Wyoming is often included in the range of *J. brachyphyllus* (Abrams, 1955; Peck, 1941; Davis, 1952). This is probably based upon the holotype bearing the locality "Upper Platte" (*Hayden 23* [G] since the Upper Platte River (=North Platte) enters central Wyoming from Nebraska. However, on the basis of known distribution, the holotype was more likely collected in Nebraska.

REPRESENTATIVE SPECIMENS. WASHINGTON: Columbia Co.: Blue Mts., moist hillsides, *R. M. Horner R198B497*; July 17, 1897 (G); Klickitat Co.: Bingen, wet places and damp cliffs, *W. N. Suksdorf 3817*, 4 June 1897 (G). OREGON: Jackson Co.: Trail, dry watercourse, *M. E. Peck 19327*, July 16, 1936 (WTU); Union Co.: 9 mi. s. Hilgard, Starkey Exp. Forest, *F. J. Herman 18833*, July 15, 1963 (WTU). IDAHO: Nez Perce Co : Lake Waha, *Heller 3410* (G, paratype); Latah Co.: 4 mi. s. e. Moscow, Tomer's Butte, moist slope, *W. H. Baker 14288*, July 9, 1956 (WTU). NEBRASKA: Sioux Co.: *A. T. Woods*, 1892 (NEB); Cherry Co.: Kennedy, *Bates*; Aug. 6, 1913 (NEB); Upper Platte, *Hayden* (G, holotype). KANSAS: Rice Co.: 10 mi. n.-4 mi. w. Hutchison on McPherson-Rice Co. road, stabilized sand dune prairies, *L. J.*

Harms 1922, 11 Aug. 1964 (KANU); Ellsworth Co.: east end of Kanopolis Reservoir, Horsethief Canyon, low sandy swales, L. J. Harms *1957*, 12 Aug. 1964 (KANU). ARKANSAS: Franklin Co.: 6½ mi. w. n. w. of Paris, very sandy abandoned fields on flat plateau of Horseshoe Mt., *H.* and *Grace Illtis 5398-B*, June 10, 1955 (SMU). OKLAHOMA: Custer Co.: 1 mi. e. of Weatherford, sand in small stabilized dunes, *U. T. Waterfall 7342*, July 3, 1947 (OKU); Murray Co.: 2½ mi. n. Daughtery, red clay and sand open woods, *Waterfall 6041*, June 2, 1945 (OKS, SMU). TEXAS: Wise Co.: Grand Prairie 1 mi. w. of Paradise, low grounds, *E. Whitehouse 15256*, Apr. 13, 1946 (SMU); Bosque Co.: 12½ mi. n.-n. e. of Walnut Springs, fine sand over limestone above Brazos River terrace, *L. H. Shinners 11318*, May 26, 1949 (SMU).—*Larry J. Harms, Systematic and Environmental Biology, Biological Sciences Group, University of Connecticut, Storrs, Connecticut 06268.*

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NOTES ON THE DISTRIBUTION OF *TRILLIUM GRACILE* AND *TRILLIUM RECURVATUM* (LILIACEAE) IN TEXAS[1]—During the spring of 1968, collecting trips were made to ascertain and document the present distributions of two sessile-flowered *Trillium* species in Texas. *Trillium gracile* J. Freeman (1969), which is listed in the literature as *T. ludovicianum* Harbison (Gould, 1962), was reported to be the more common species in eastern Texas, whereas *T. recurvatum* Beck had not been reported from the state. The probable occurrence of the latter species in Texas was suggested to us by a single specimen (cited below) that was collected in 1942 by a student and deposited without identification in the Stephen F. Austin State College Herbarium. This find evidently was not duplicated or otherwise substantiated until this past spring.

Our collections include additions and extensions to the known ranges of both species. Several new locations for *Trillium gracile* were found in Shelby, Sabine and San Augustine Counties. The location in San Augustine County

[1] This project was partially supported by Stephen F. Austin State College Faculty Research Grant 1650 to E. S. Nixon.

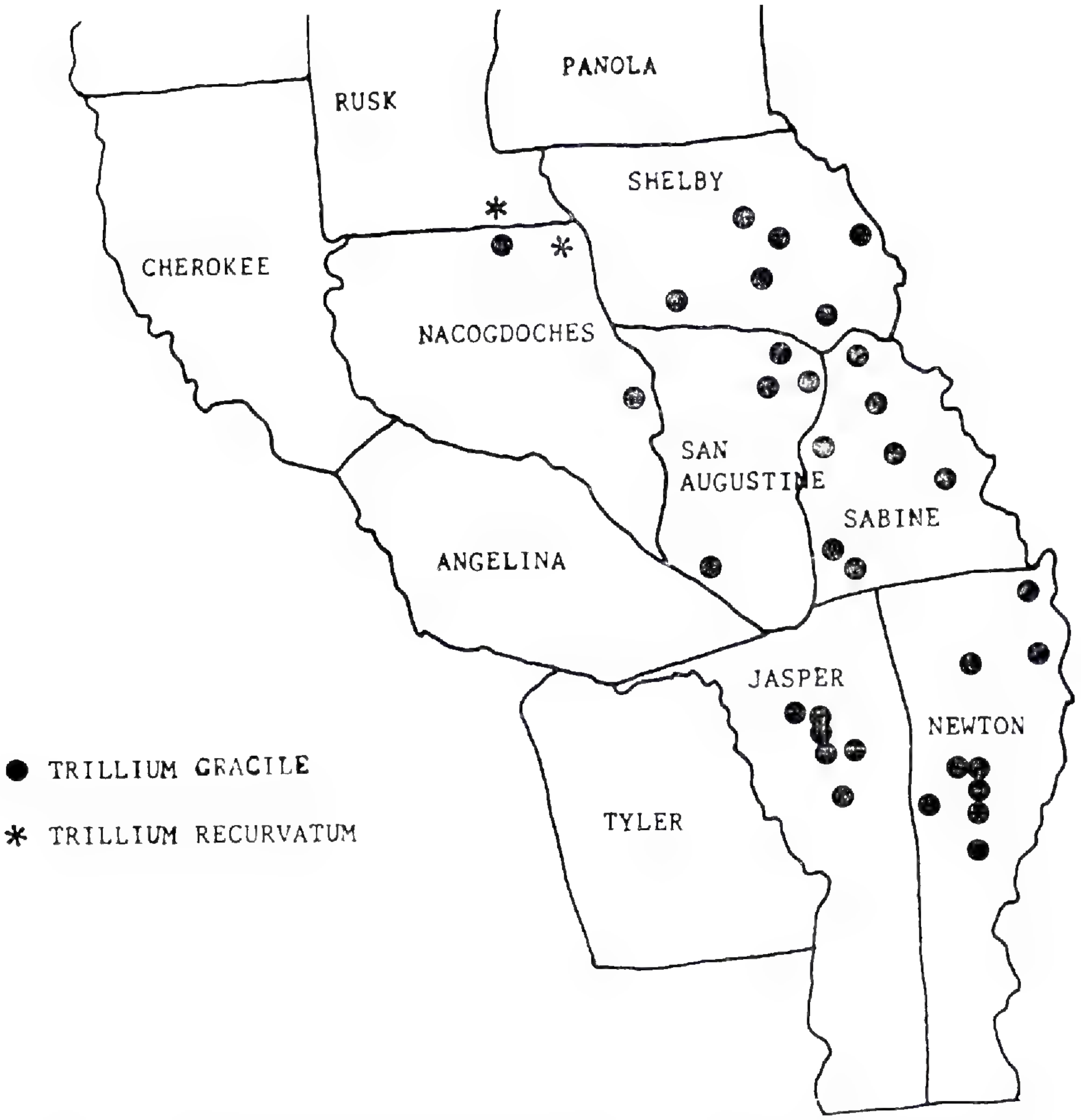

Fig. 1. Distribution of *Trillium gracile* and *T. recurvatum* in east Texas.

was the westernmost yet discovered within that county. A county record for this species in Nacogdoches County was established. *Trillium recurvatum* was collected in Rusk County, which substantiates the older student collection from Nacogdoches County as a new state record for this species. The Rusk County population of *T. recurvatum* proved to be the westernmost and the southernmost station recorded for this species, the nearest locality known to us being along the Red River bluffs in northwestern Louisiana. Figure 1, indicating the documented distribution of *T. gracile* and *T. recurvatum* in Texas, was based upon vouchers deposited at the Stephen F. Austin State College Herbarium (ASTC) and the Vanderbilt University Herbarium (VDB), as well as other material cited in an earlier paper (Freeman, 1969).

As a result of the establishment of reservoirs in the riverbottom areas and the continued effect of grazing, other *Trillium* populations in east Texas may become more difficult to locate. On several occasions, small populations of

T. gracile were observed in which the plants had been grazed to the extent that only the lower parts of the scapes were present.
Trillium gracile J. Freeman

Nacogdoches Co.—One mi. sw. of Chireno on the Woden road, riverbottom area under fairly heavy tree cover, brown sandy-loam soil: 29 Apr. 1967, *Nixon* and *Muse 332*, and 11 Apr. 1968, *Nixon* and *Muse 433*; From Nacogdoches n. turn left off U. S. 59 by Lakeside Nursing Home, go ca. 4 mi. n. on road taking n. road at two intersections, on west side of road along creek under pine-hardwood cover: 11 Apr. 1968, *Nixon* and *Sullivan 446*; San Augustine Co.—Harvey's Creek Recreational Area, Sam Rayburn Lake, sloping hill near lake under pine-hardwood trees: 18 Apr. 1968, *Nixon* and *Muse 550*.
Trillium recurvatum Beck

Nacogdoches Co.—Garrison, growing in moist woodland: 10 Apr. 1942, *Williams s.n.* Rusk Co.—Langston forest, ca. 4 mi. n. on Freewill Baptist Church road on right ca. 200 yds. into creek area, creek bottom area with large pines and hardwood trees, frequent in small populations: 27 Mar. 1968, *Nixon, Sullivan* and *Brown* 413.—*E. S. Nixon, J. R. Sullivan, J. T. Brown, Stephen F. Austin State College, Nacogdoches, Texas 75961; Janice B. Lacey, Drawer 1312, Nacogdoches, Texas 75961; J. D. Freeman, Department of Botany and Plant Pathology, Auburn University, Auburn, Alabama 36830.*

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NOVELTIES IN LYGODESMIA AND STEPHANOMERIA (COMPOSITAE-CICHORIEAE).—It seems advisable to report the following new species and new combinations at this time because a forthcoming monograph of *Lygodesmia* (A Cytotaxonomic Study of the Genus *Lygodesmia* (Compositae-Cichorieae), Ph.D. dissertation, The University of Texas at Austin, 1970) will not appear in print for at least a year. I have treated *Lygodesmia* and *Stephanomeria* as distinct genera because they differ in their base chromosome numbers, pollen grains, achenes, and cotyledon morphology (details in the dissertation just cited). The work here reported was supported in part by N. S. F. Training Grant GB 6914.

LYGODESMIA **arizonica** Tomb, sp. nov. Perennis herbacea. Folia basalia non rosularia, suprema ca. 2.0—4.0 cm longa, linearia, integra (nec brevissima squamiformia sicut in L. dianthopside). Achaenia 1.0—1.3 cm longa facie adaxiali valde sulcata, abaxiali obscure rugosa. ARIZONA, Coconino Co.: on sandy soil of mesa, 17 miles NE of Tuba City on road to Kayenta, Navajo Indian Reservation, *C. T. Mason & W. S. Phillips 1914*, 6 June 1961 (holotype TEX, isotypes ARIZ and UT) (illustrated).

G.K.

Herbaceous perennial, 5-25 cm tall (usually 15 cm or less); roots not woody, usually deep seated and stoloniferous, bearing 1 to several rhizomes, rhizomes usually ca 4-7 cm long unbranched, covered with a thin, light brown periderm; stems branched from base, glabrous, not striate; basal leaves linear 4-8 cm long, 0.3-0.6 cm wide, entire, not midribed, ascending, thick; cauline leaves similar to basal, numerous, progressively shorter near the summit, but not reduced to scales; heads one to several, 5-flowered (rarely 7-flowered); involucre cylindroid 1.8-2.5 cm long, ca 5 mm wide at anthesis; principal involucral bracts 5, linear 1.7-2.3 cm long, ca 3 mm wide, elongating slightly before fruit maturity, obscurely midribed, outer surface scabrate, margins hyaline, apices usually unappendaged; outer involucral bracts, subulate much shorter, in ca one series, margins ciliate, forming a calyculum; ligules before drying pale pink 1.8-2.5 cm long, ca 0.6-1.0 cm wide, usually slightly narrowed at their apices; corolla tube 1.0-1.1 cm long; anthers 0.7-0.9 cm long, exserted ca 4-8 mm, pale pink or white; style branches ca 2-4 mm long; receptacle narrow, flat, bearing achene scars around the outer edge; achenes sub-cylindric 1.0-1.3 cm long, ca 1.5-2.0 mm wide, 4-6 angled, strongly sulcate and rugose on the adaxial surface, the abaxial surface obscurely sulcate and rugose, usually abruptly narrowed below the summit; pappus bristles capillary, ca 1.4 cm long, often basally connate; sap; milky white, pollen grains echinolophate, tricolporate, mean equatorial diameter 56.2 microns; chromosome number, $n = 9$.

Distribution: Sandy soil in desert areas of northwestern Arizona, southeastern Utah, and adjacent New Mexico and Colorado; 4,000 - 5,500 ft. May - June.

This species and the following have been treated previously as belonging to *Lygodesmia grandiflora*. They differ from the latter taxon in habit, number of flowers per head, sculpturing of their achenes and distribution (Tomb, 1970).

LYGODESMIA **dianthopsis** (Eaton) Tomb, comb. nov.

Lygodesmia juncea var. *dianthopsis* Eaton ex King. U. S. Geol. Explor. 40th Par. 5:200. 1871.

This species is distinguished from the closely related *L. arizonica* by its shorter upper leaves, attenuate achene summits, and distribution.

STEPHANOMERIA **spinosa** (Nutt.) Tomb, comb. nov.

Lygodesmia spinosa Nutt., Trans. Am. Phil. Soc. ser. 2. 7:444. 1841.

Pleiacanthus spinosus (Nutt.) Rydb., Fl. Rocky Mount. 1023. 1917.

I have transferred this remarkable spiny plant to *Stephanomeria* because of its gross morphology, echinate pollen grains and base chromosome number of x = 8. The last two characters are found in all species of *Stephanomeria* examined to date. *Lygodesmia* has echinolophate pollen and base chromosome numbers of x = 9 and x = 6.—*Andrew Spencer Tomb, Department of Botany, The University of Texas at Austin, Texas 78712.*

DOCUMENTED PLANT CHROMOSOME NUMBERS 70:1

CARL S. KEENER
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University Park, Pennsylvania 16802

Figures 1-25 are camera lucida drawings.

CHENOPODIACEAE[a]

CHENOPODIUM Section BOTRYOIDES C. A. Meyer

CHENOPODIUM BOTRYS L.[b,c] (Fig. 1.) 2n=18. ORE., Douglas Co.: *Wahl 21742* (PAC).

CHENOPODIUM GRAVEOLENS Willd. var. *NEOMEXICANUM* (Aellen) Aellen.[d] (Fig. 2.) 2n=32. ARIZ., Coconino Co.: *Wahl 21901* (PAC).

CHENOPODIUM Section DEGENIA Aellen

CHENOPODIUM CHENOPODIOIDES (L.) Aellen var. DEGENIANUM (Aellen) Aellen.[b] (Fig. 3.) 2n=18. CALIF., Tulare Co.: *Howell and True 43894* (PAC).

CHENOPODIUM MACROSPERMUM Hook. f. var. FARINOSUM (S. Wats.) J. T. Howell.[b] (Fig. 4.) 2n=36. CALIF., San Diego Co.: *Wahl 21776* (PAC).

CHENOPODIUM Section Chenopodia (C. A. Meyer) Aellen

CHENOPODIUM ALBUM L. var. ALBUM.[b,c] (Fig. 5.) 2n=54. PA., Lackawanna Co.: *Wahl 21669* (PAC).

CHENOPODIUM ALBUM L. var. LANCEOLATUM (Muhl.) Coss. & Germ.[d] (Fig. 6.) 2n=54. CANADA, ONTARIO, Nipissing Co.: *Wahl 19910* (PAC).

CHENOPODIUM ALBUM L. var. STEVENSII Aellen.[d] (Fig. 7.) 2n=54. CALIF., Los Angeles Co.: *Wahl 21750* (PAC).

CHENOPODIUM ATROVIRENS Rydb.[d] (Fig. 8.) 2n=18. NEW MEXICO, Catron Co.: *Wahl 21928* (PAC).

CHENOPODIUM BERLANDIERI Moq. var. SINUATUM (Murr) H. A. Wahl.[b] (Fig. 9.) 2n=36. CALIF., Ventura Co.: *Pollard s.n.* (PAC).

CHENOPODIUM BERLANDIERI Moq. var. BOSCIANUM (Moq.) H. A. Wahl.[d] (Fig. 10.) 2n=36. FLORIDA, Leon Co.: *R. A. Pursell s.n.* (PAC).

CHENOPODIUM BUSHIANUM Aellen.[c] (Fig. 11.) 2n=36. ARK., Sevier Co.: *Demaree 54626* (PAC).

CHENOPODIUM DESICCATUM A. Nelson var. DESICCATUM.[d] (Fig. 12.) 2n=18. CALIF., Kern Co.: *Wahl 21896* (PAC).

CHENOPODIUM DESICCATUM A. Nelson var. LEPTOPHYLLOIDES (Murr) H. A. Wahl.[b,c] (Fig. 13.) 2n=18. CALIF., Monterey Co.: *Twisselmann 8790* (PAC).

CHENOPODIUM FOGGII H. A. Wahl.[b] (Fig. 14.) 2n=18. CANADA, ONTARIO, Lambton Co.: *Gaiser 3383* (PAC).

SIDA 3 (7): 533—536. 1970.

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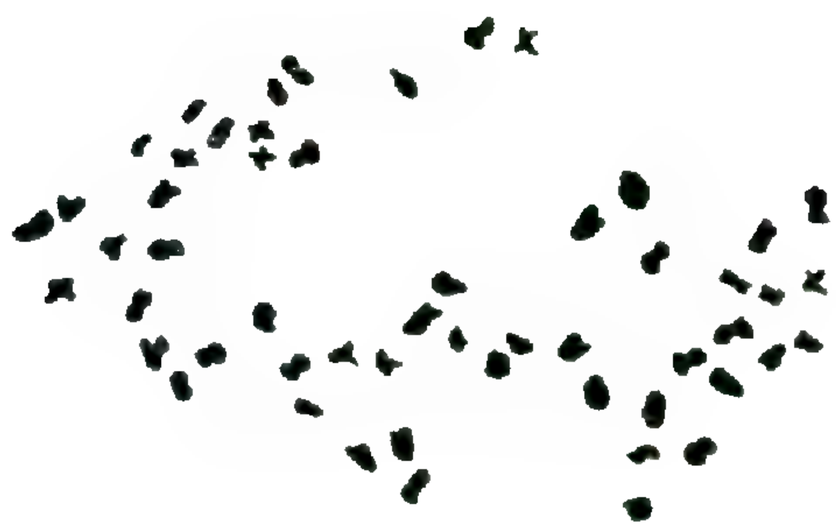

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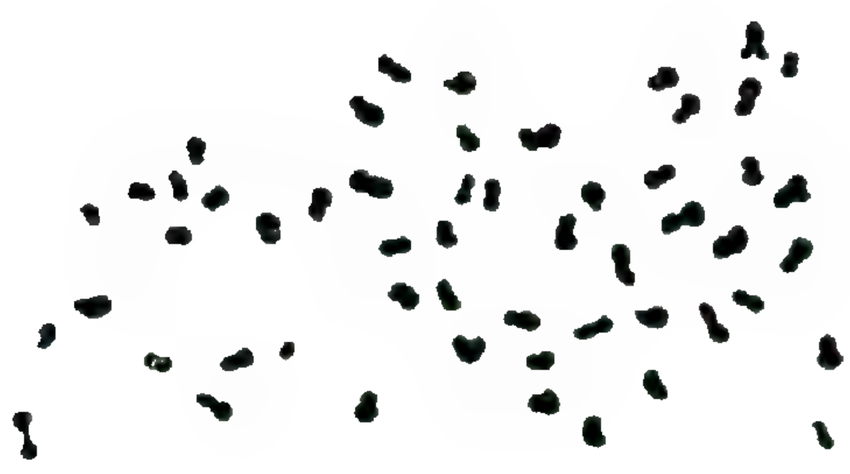

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CHENOPODIUM FREMONTII S. Wats.[d] (Fig. 15.) 2n=18. ARIZ., Pima Co.: *Wahl 21823* (PAC).

CHENOPODIUM HIANS Standley.[d] (Fig. 16.) 2n=18. TEXAS, Jeff Davis Co.: *Wahl 21828* (PAC).

CHENOPODIUM INCANUM (S. Wats.) A. A. Heller.[d] (Fig. 17.) 2n=18. TEXAS, Jeff Davis Co.: *Wahl 21827* (PAC).

CHENOPODIUM INCOGNITUM H. A. Wahl.[d] (Fig. 18.) 2n=18. CALIF., Los Angeles Co.: *Wahl 21756* (PAC).

CHENOPODIUM LEPTOPHYLLUM Nutt. ex Moq. in DC.[d] (Fig. 19.) 2n=18. CALIF., Los Angeles Co.: *Wahl 21757* (PAC).

CHENOPODIUM MISSOURIENSE Aellen.[b,c] (Fig. 20.) 2n=54. ARK., Pike Co.: *Demaree 53160* (PAC).

CHENOPODIUM NEOMEXICANUM Standley.[d] (Fig. 21.) 2n=18. ARIZ., Pima Co.: *Wahl 21826* (PAC).

CHENOPODIUM STANDLEYANUM Aellen.[d] (Fig. 22.) 2n=18. ARK., Hot Springs Co.: *Demaree 56477* (PAC).

CHENOPODIUM STRICTUM Roth var. STRICTUM.[c] (Fig. 23.) 2n=36. CALIF., Tulare Co.: *Wahl 21905* (PAC).

CHENOPODIUM STRICTUM Roth var. GLAUCOPHYLLUM (Aellen) H. A. Wahl.[b] (Fig. 24.) 2n=36. CALIF., Tulare Co.: *Wahl 21904* (PAC).

CHENOPODIUM WATSONII A. Nelson.[d] (Fig. 25.) 2n=18. NEW MEXICO, Catron Co.: *Wahl 21929* (PAC).

FOOTNOTES

[a] All counts were made from root tips of seedlings raised from seed taken from the indicated voucher specimens.

[b] Taxon for which the same chromosome count has been published previously.

[c] Taxon for which a chromosome count differing from this one has been published previously.

[d] No chromosome number reported previously for this taxon.

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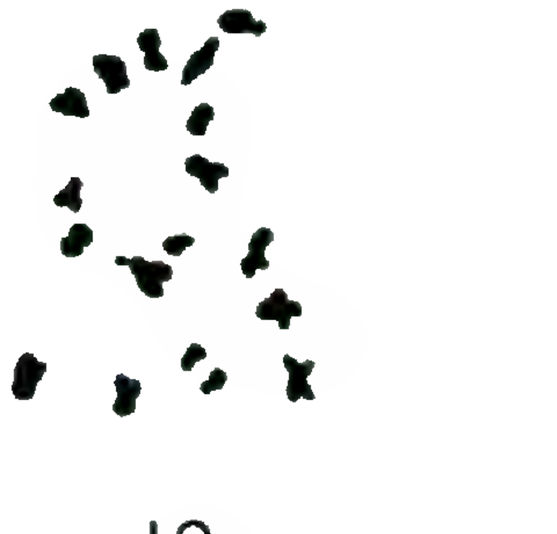

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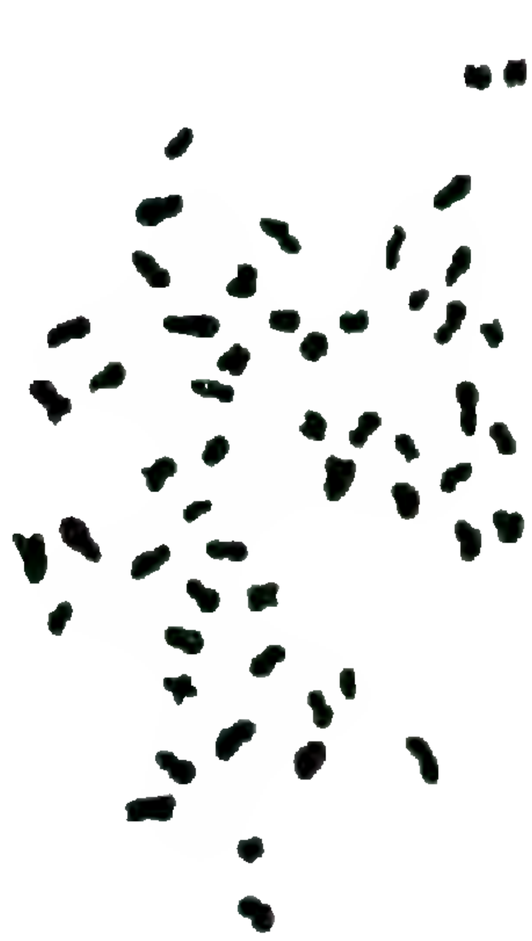

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0.01 mm

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Names of contributing authors are in capital letters. New scientific names are in boldface followed first by page on which formally published (sometimes not the first page on which mentioned). Synonyms are in italics. Illustrations are indexed only by captions, in some cases on an opposite page. Geographic locations are indexed only when appearing in a title.

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